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Washington Highlights

With a Republican House after e November elections almost a regone conclusion, President Truan is making preparations to equaze the situation for the Democratic arty as much as possible. Predicons of New Dealers of a narrow emocratic majority is construed competent political observers as "whistling in the dark" attitude.

History of the country indicates at when a representative minority rty in the House wins in an off ar election, victory is inevitably peated two years later in the camign for President.

The temper of the average citizen wards the party in power is illusated by the latest Gallup poll of oters, which disclosed that the hief Executive had fallen to a low oint of 32 per cent from a high oint of 87 per cent recorded shortly ter Mr. Truman took office.

* * *

Oil industry representatives were ld by Government experts that deand for synthetic rubber will be gh enough to keep plants in the nited States operating at capacity r the next six or eight months, twithstanding mounting supplies natural rubber.

Although opinions differ as to rospects after that period, most exrts concur that synthetic output n be maintained throughout 1947 current levels. The Government vested $670,000,000 in 51 producg plants, the chief reliance of the tion since war cut off supplies of tural rubber, of which about half e still in operation.

American Petroleum Institute 26th Annual Meeting

With the spotight on agriculture, public relations, and the future, the Twenty-sixth Annual Meeting of the American Petroleum Institute, the second since the war's end but the first in a full peacetime year, will be held in the Stevens Hotel, Chicago, November 11-14, 1946. In line with the announced policy of the Institute to broaden the scope of its work and to be of service to every facet of industry, as well as in full resumption of its program of expanded activity interrupted by the war, the program this year has been enlarged to comprehend addresses and events of general interest in addition to those technical matters of interest purely to the industry itself.

In the Second November, 1946, issue of California Oil World will appear an abstract of the papers which are of interest to the personnel of the California petroleum industry.

Certain papers of special interest will be carried in full.

The Civilian Production Administration recently announced that August tire production reached a record high of 18 per cent above the production figure for the preceding month. Passenger car tire output in August was 5,800,000 units. Truck and bus tire output for the month was 1,300,000.

Expectations are that the final draft of the new oil and gas leasing rules will be completed within two weeks. These regulations, drafted by the Department of the Interior, to carry out the Federal Leasing Act as recently amended, were discussed by Government officials and a committee of representative oil men in Denver. California member of the committee is A. C. Mattei, president of Honolulu Oil Corp.

Transcript of the meeting is anticipated shortly. The Bureau of Land Management will then begin formulating final rules to properly implement the new law.

* * *

The House committee on un-American activities has completed its investigation of the CIO-PAC since the death of Sidney Hillman and a report is now being drafted. It probably will not be released for public consumption, however, until after Congressional elections on November 5. A number of Senators and Representatives are prominently mentioned in the report, Washington heard.

* * *

The Natural Gas Industry must redouble its efforts to conserve gas. So declared J. A. Krug, Secretary of the Interior, at the annual meeting of the American Gas Association in Atlantic City. Mr. Krug, who is scheduled to address the meeting of the American Petroleum Institute at Chicago in November, said at that time he will ask oil men to give all help possible to gas conservation.

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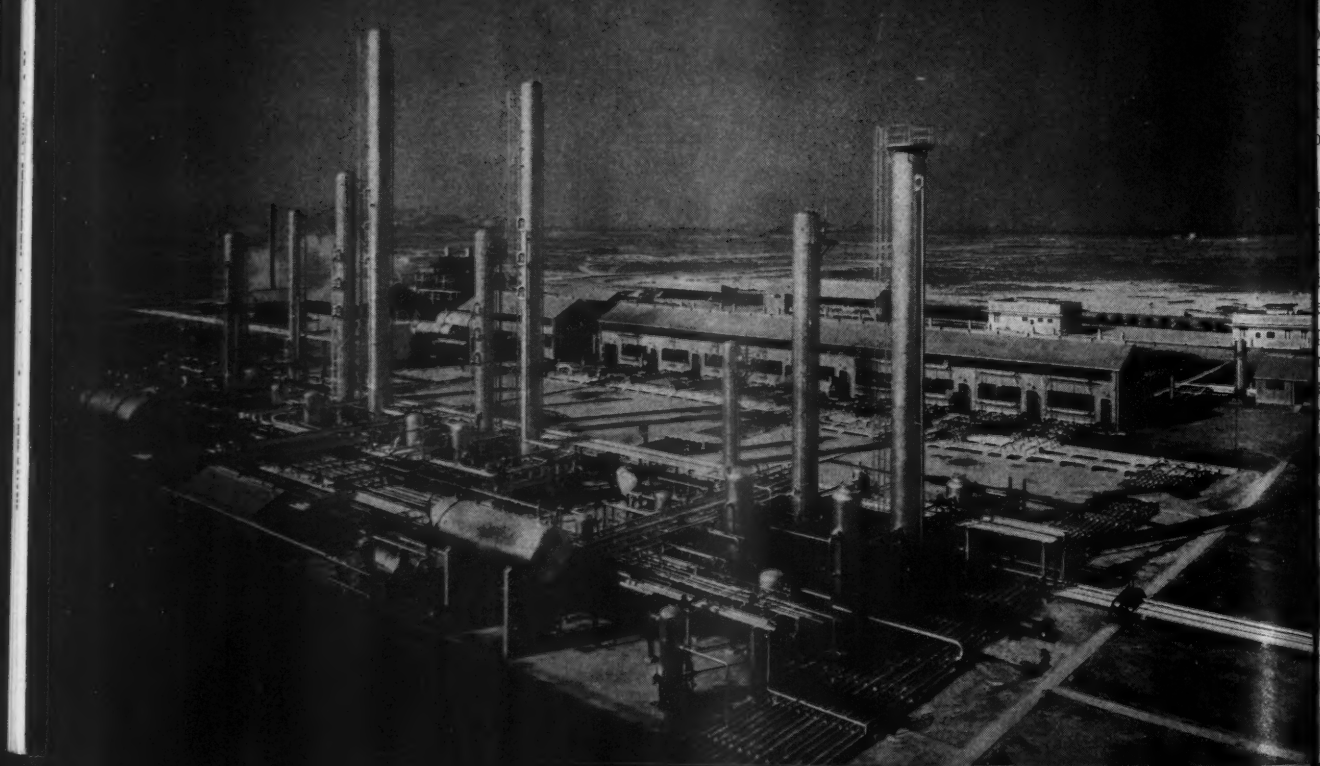

The Conversion of Natural Gas to Liquid Fuels

By R. C. Alden
Director of Research,
Phillips Petroleum Company,
Bartlesville, Oklahoma

October Meeting

About twenty-five years ago, Franz Fischer and Hans Tropsch of the Kaiser Wilhelm Institute in Germany, commenced a systematic laboratory study of catalysts and conditions required for the efficient production of liquid and solid hydrocarbons from water gas. Water gas was already being produced commercially in Germany in tremendous quantities for use in the production of synthetic methanol and as a source of hydrogen for the ammonia synthesis, hydrogenation of coal and other hydrogenation processes. By 1925 these two investigators had succeeded in developing an active cobalt catalyst which could be used at near atmospheric pressure to give good yields of liquid hydrocarbons.

On the assumption of power by Hitler and the formation of the Third German Reich the process was pushed forward with increased vigor as were all industrial processes which enhanced the self-sufficiency of the German Nation in preparation for the coming struggle. By 1933, the first large-scale installation was on stream at Oberhausen. The Fischer-Tropsch process showed a steady rise in commercial production from this time on until the beginning of the war.

According to the U. S. Strategic Bombing Survey, Germany was producing only a third of her fuel requirements in 1936. In 1939, through installation of more Fischer-Tropsch and coal hydrogenation plants, Germany went to war with reserves of 3.1 months' war needs of aviation gasoline and 1.9 months' needs of motor fuel.[1] This was certainly sufficient as planned for a blitzkrieg war. But as we know, the blitzkrieg war lulled into a "phony" war and then launched into a war of such gigantic proportions that for the duration, Germany fought successive crises of insufficient oil stocks. Near the end of the war, she had scarcely enough reserves to wet the bottoms of her tanks.

At the time of the invasion of Poland, Germany had seven large hydrogenation plants and seven Fischer-Tropsch plants operating. At least four more hydrogenation plants, including a large one at Poelitz, and two more Fischer-Tropsch plants were under construction. During the "Phony" stage of the war, between September 1939 and May 1940, Germany's synthetic oil plant capacity was increased roughly from 13,100,000 to about 16,600,000 barrels annually.[2]

In Figure 1, is shown the German production of petroleum products during the war years.[3] The most striking feature of this plot is the precipitous decline early in 1944 as a result of the inauguration of the Allied strategic bombing missions. Also to be noticed is the tremendous increase in war-time production of synthetic oil by hydrogenation of coal, dwarfing all other methods of production. Actually, Fischer-Tropsch plants played a relatively minor role in the German synthetic oil program during the war. Several explanations have been offered. In the first place, it appears that a political race was going on between I. G. Farbenindustrie which owned the hydrogenation plants and patents and the Ruhrchemie which owned the Fischer-Tropsch plants and patents. I. G. won the race in spite of the fact that their process was the more costly. But there was also at least one sound technical reason why the coal

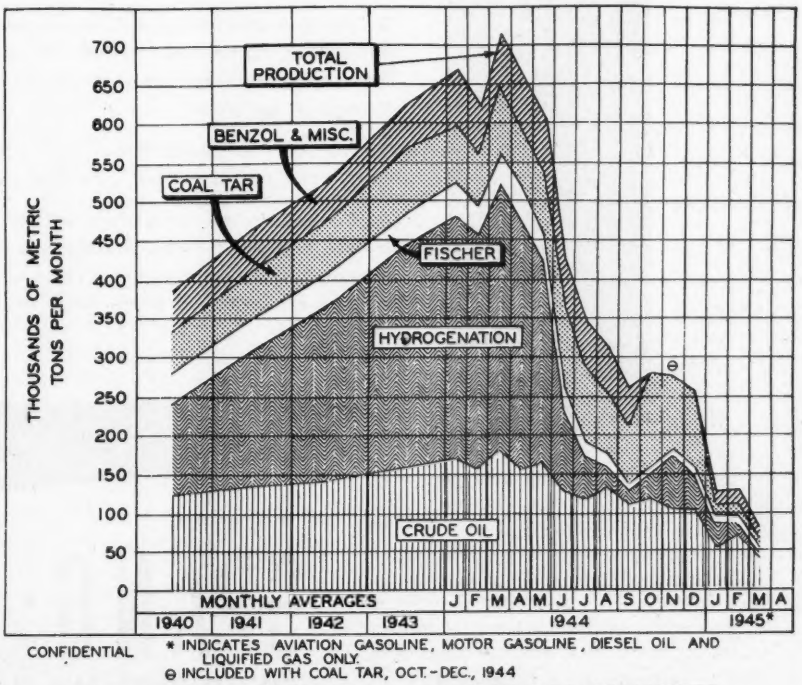

FIG. 1 GERMAN PRODUCTION OF PETROLEUM PRODUCTS[3]

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hydrogenation process was favored. It produced directly gasoline of a higher octane rating suitable for aviation base stock. The Fischer-Tropsch process on the other hand produced a highly paraffinic product which would be converted into motor fuel or aviation fuel only by drastic refining steps.

The development in Germany of Fischer-Tropsch processes utilizing iron catalysts, producing high octane gasoline directly, was only in pilot plant stage at the end of the war and thus came too late to participate in the German war effort. Such processes, had they been developed earlier, may have given the Fischer-Tropsch process a more significant war role in Germany. Before discussing American developments, some of which are proceeding to commercial application and which have improved greatly the German processes using iron catalysts both technically and economically, it might be interesting to point out some of the engineering features of commercial scale German plants that were operated during the war.

Figure 2 shows a flow sheet for the typical German plant of the atmospheric pressure type.[4] This was the most common type of plant used in Germany. Only a very small percentage of Fischer-Tropsch output was produced by the so-called medium pressure process.

Water gas for Fischer-Tropsch operation was universally produced by all plants in the Ruhr by the conventional water-gas reaction utilizing coke. The reaction was carried out in standard, intermittent water gas sets involving no significant differences from well-known American practice.

In order to obtain the higher ratio of hydrogen to carbon monoxide required for the standard Fischer-Tropsch operation, it was necessary to pass a portion of the water gas through converters containing the so-called shift catalyst, whereby carbon monoxide was converted into hydrogen and carbon dioxide. This step is not shown on the flow sheet. Steam was introduced with the gas and the conversion was carried out at about 900 F. The carbon dioxide was subsequently scrubbed

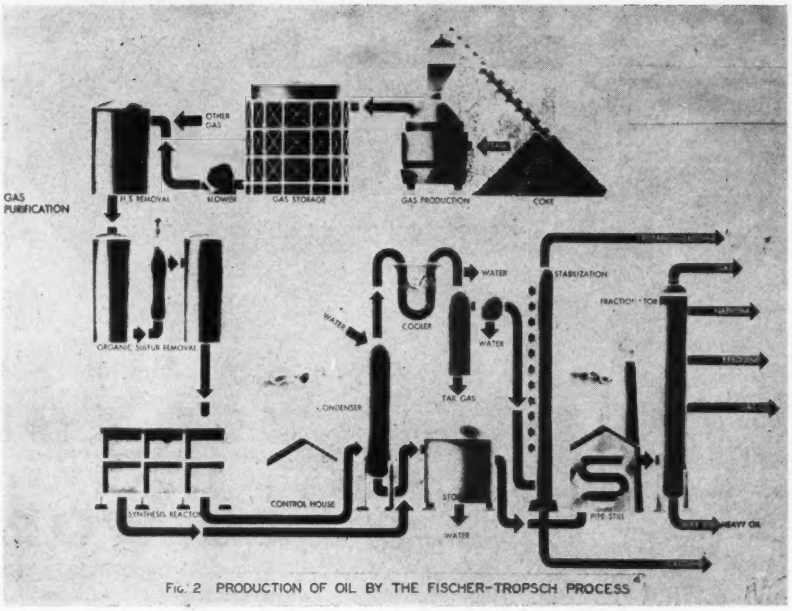


FIG. 2 PRODUCTION OF OIL BY THE FISCHER-TROPSCH PROCESS

out and the remaining hydrogen combined wth the unconverted portion of water gas to give a gas containing approximately two parts of hydrogen to one of carbon monoxide plus 8 to 10 per cent impurities or inerts such as nitrogen, methane and carbon dioxide.

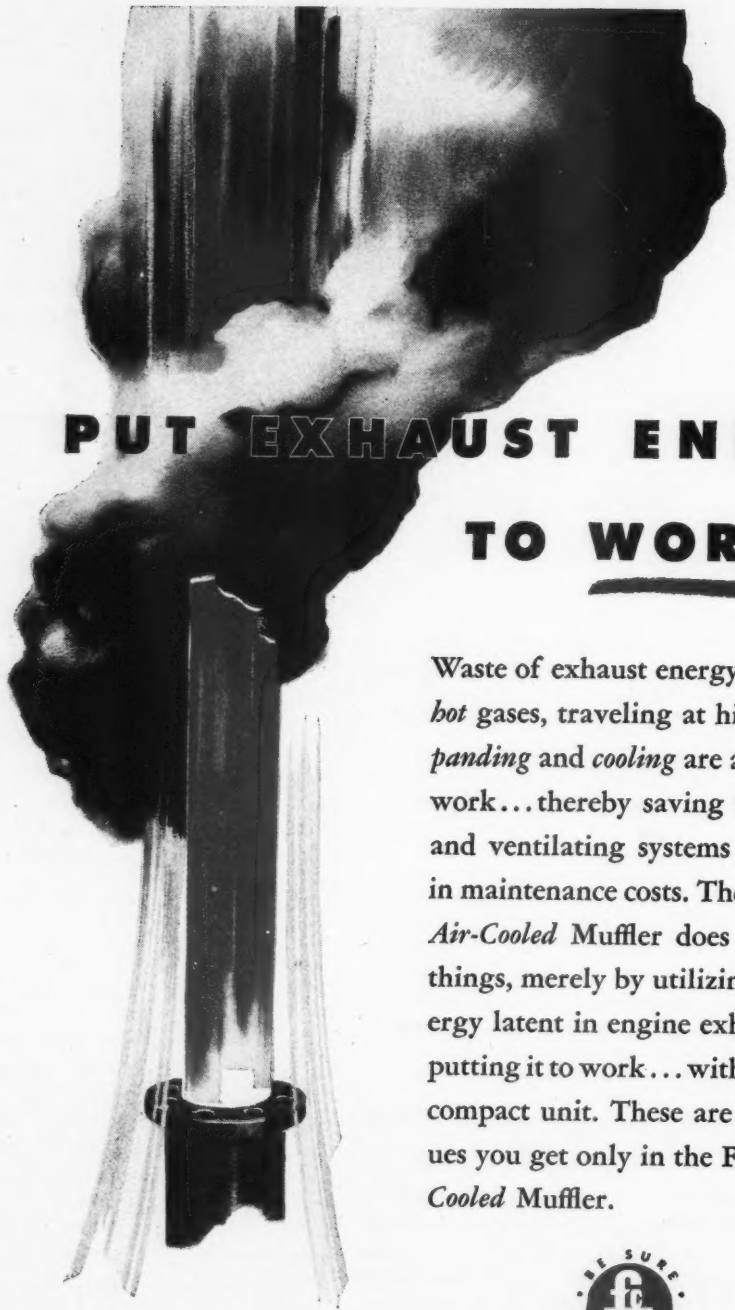
Although the conventional water gas reaction was used in all plants for making water gas, at least two plants in the Ruhr and possibly others were supplementing their production of synthesis gas from coke by processes based on either coke oven gas or brown coal.

Sulfur is a troublesome element in the Fischer-Tropsch process and must be removed from synthesis gas before entering the synthesis chambers. The tolerance is about 0 1-0.2 grains per 100 cubic feet. The removal is carried out in two stages. Stage 1 is the removal of hydrogen sulfide and stage 2 is the removal of organic sulphur such as carbon disulfide and mercaptans. In Germany the hydrogen sulfide was generally removed by the well-known iron-oxide method consisting merely of contacting synthesis gas with iron oxide at normal temperature. Organic sulphur was generally removed by contacting the synthesis gas with a catalyst at temperatures varying from 350 F with fresh catalyst to 540 F with nearly exhausted catalyst. A captured sample of catalyst from the Rheinprussen plant showed ferric oxide and sodium carbonate to be the chief constituents.

The synthesis gas with sulfur removed passes into the reaction chamber where the synthesis of hydrocarbons takes place. The temperature in this converter varies with the age of the catalyst from about 356 to 383 F; the pressure is substantially atmospheric. The catalyst chamber is cooled indirectly by circulating water. The products and unconverted gas are separated in the condenser and cooled by a water spray. Unconverted gas containing considerable light ends passes either to large vessels containing activated carbon or to a cooler where light oil vapors and gaseous hydrocarbons are recovered. Product is obtained from activated carbon by periodical steam-stripping. The heavier condensed product is separated from the water layer and is subsequently refined and stabilized by conventional methods.

The flow diagram does not illustrate vividly enough the tremendous amount of equipment required in the conventional German process. The Meerbeck plant,[5] for example, having an installed capacity of about 1500 B/D of total product had 11 gas preparation units covering 2½ acres of land, and in addition:

4 parallel sets of hydrogen sulfide removal towers each 30 feet



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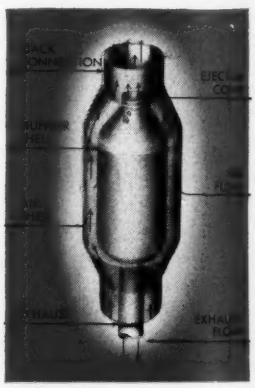

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The heart of the Fischer-Tropsch plant is the synthesis chamber and nothing shows the complexity of the German process more than this section of the plant. Figure 3 shows a typical set of atmospheric pressure converters. As previously stated, 100 of these are required for 1500 B/D capacity. These chambers are small and complicated, designed to remove the enormous heat of reaction which is about 7000 BTU per pound of product. Each chamber consists of an array of metal fins about 0.28 inches apart. Tranversely through these fins are cooling tubes about 1.5 inches in diameter through which water flows as a cooling agent. The headers for collecting the steam produced are shown. The amount of steam obtained in this manner is practically enough to supply the power requirements of the plant. Catalyst, cobalt-thoria, is packed between the fins.

Figure 4 shows a few Fischer-Tropsch reactors after an Allied bombing raid. This picture reveals vividly the grief that must attend the repair of such complicated equipment.

In Table I some of the pertinent operating data and yields for a typical plant are given.[5,6,7] Again this is the Meerbeck plant mentioned previously.

TABLE I

Operation and Yields: Typical German Fischer-Tropsch Plant.[5,6,7]

Operation

65 1st Stage Converters; 35 2nd Stage Converters.

100 Total Converters.

Gas Contraction, 1st Stage - 50 per cent.

Overall gas contraction - 75 per cent.

Temperature - 356 to 392 F.

Pressure - 2 psig.

Production (Wt. per cent)

Gasoline - 52.2 Heavy Oil - 10.7
Diesel Fuel - 15.8 Crude Wax - 11.3
Bottled Gas - 10.0

Yields

Total Plant Yield Approx. 15 B/D

Gals/M cubic feet synthesis gas - 1.16 to 1.6

Raw materials per M cubic feet of synthesis gas: 39 lbs. coke, 159 cubic feet of coke oven gas.

From these data, it is readily seen that German Fischer-Tropsch plants were quite complex and actually made up of many small units. For example the daily capacity of a single synthesis unit averaged about 15 barrels which is hardly more than pilot plant size. The plants in general were very sparsely instrumented and necessitated the employment of large operating staffs for hand control.

Such plants were too expensive, complex and too small in unit size to fit in with American standards of petroleum production. Nevertheless, the alarming predictions concerning the dwindling petroleum reserves in the United States turned the attention of technical men in this country toward the production of synthetic fuels and in the last few years much of this attention has been focused on the development of modified Fischer-Tropsch processes. It is not my purpose to take a stand on whether U. S. reserves of petroleum are dwindling at an alarming rate, as some say, or whether this is merely, as others claim, hysteria which is apt to follow any period of excessive consumption. Both opinions appear in the literature. Whether new reserves are located at an increasing or decreasing rate, the alarming predictions have served a good purpose in creating an increased awareness that our petroleum supplies are not inexhaustible and have further led to greater diligence in the search for substitute sources of motor fuel.

During the last few years progress has been steadily made in the development of these processes which will compete with crude petroleum as a source of motor fuel. The developments have now reached the point where at least two organizations have announced their intentions to construct plants to produce motor fuel. They are apparently convinced on the basis of extensive pilot plant operation that the process is competitive with crude petroleum. For one of these plants, the Hydrocol Inc. plant at Brownsville, Texas, the ground will soon be broken. Construction on the Stanolind plant, according to published announcements, is expected to start within the next two or three years. The optimistic tone with which American versions of the Fischer-Tropsch process are discussed today indicate very strongly that these processes have come a long way from the cumbersome and expensive German process.

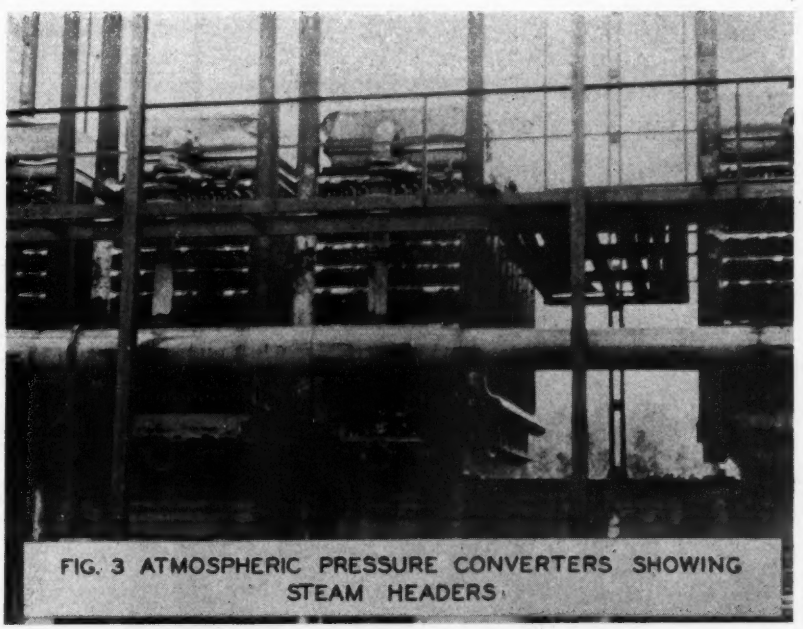

FIG. 3 ATMOSPHERIC PRESSURE CONVERTERS SHOWING STEAM HEADERS

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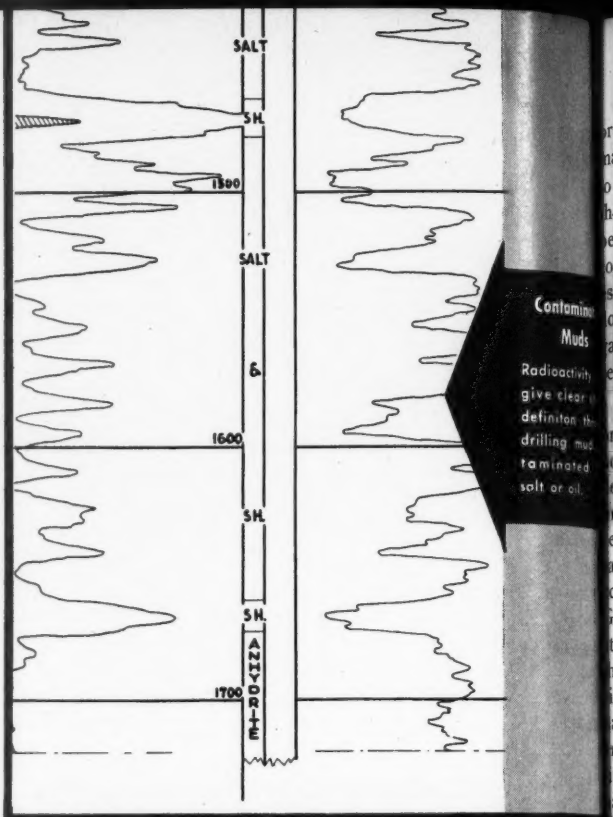

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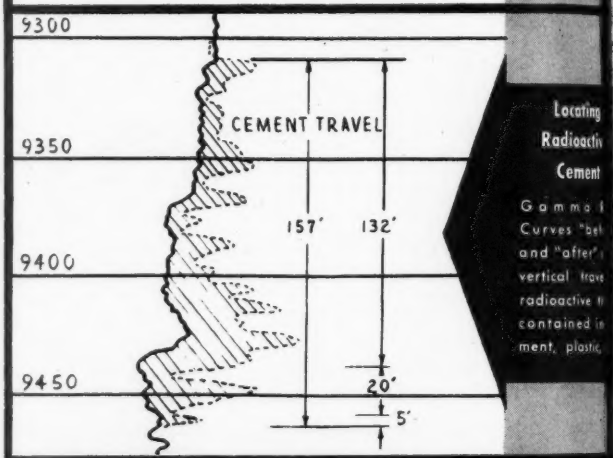

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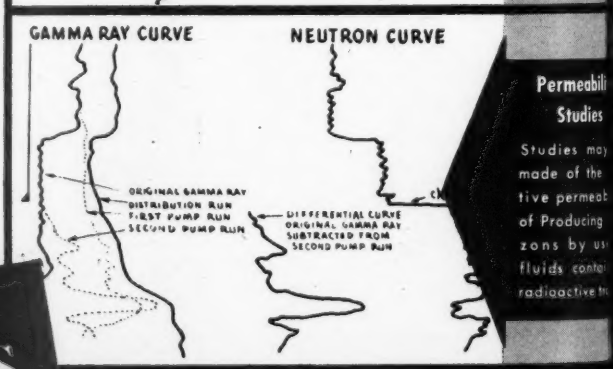

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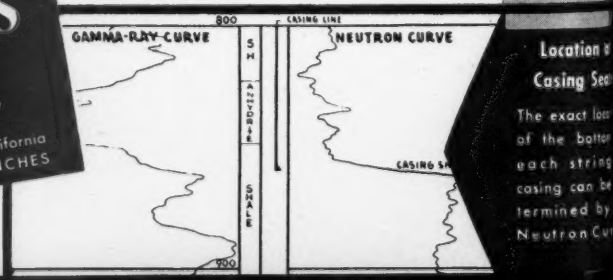

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Although not many details of the proposed U. S. plants have been made public as yet, it is worthwhile to discuss in a general way some of the major improvements which have been responsible for reducing the cost of gasoline from about 19 cents estimated for the German process down to the estimated 5 cents per gallon on the basis of improved processes.

One of the chief advantages favoring the development of an economic process in the United States depends on the huge reserves of natural gas available. The German process centered on coal as the initial raw material merely because there is scarcely any natural gas at all in Germany. It is definitely cheaper at the present time to produce synthesis gas for subsequent conversion to liquid hydrocarbons from natural gas than from coal. There are several reasons for this. In the first place, the raw material cost of natural gas per barrel of gasoline would probably average somewhat less than that of coal. With natural gas, for example, at five cents per M, its cost per barrel of gasoline produced (10,500 CF/B) is approximately 53 cents. To compare favorably with this cost, the price of coal per ton would have to be about 0 cents on the basis of 1360 pounds of coal per barrel of gasoline produced. With natural gas at 10 cents per M, the equivalent price of coal would be $1.60 per ton. Secondly, gas is simpler and cleaner to handle and therefore less expensive to convert into synthesis gas than coal. A third advantage for natural gas over coal, is the greater ease with which desulfurization can be accomplished. Sulfur in coal passes into the synthesis gas and is thence removed. Natural gas representing about one-third of the volume of synthesis gas produced from it can be desulfurized directly in one step to remove hydrogen sulfide. The organic sulfur content of natural gas is usually sufficiently low that its removal can be dispensed with.

Another advantage, linked closely with the use of natural gas, is the much larger scale of operations justifiable in the American economy. Savings are effected by the installation of manufacturing facilities of

FIG. 4 DAMAGE TO FISCHER-TROPSCH CONVERTERS BY BOMBING

larger capacity.

Before going into a discussion of the improvements which have been made in the production of synthesis gas by the natural gas route it might be well to say a word about the extent of our natural gas reserves as applied to conversion into motor fuel. DeGolyer[8] estimates the U. S. reserves to be about 140 trillion cubic feet which, on the basis of 4 gallons of gasoline per MCF, represents approximately 13.30 billion barrels of gasoline. How much of this total reserve gas could actually be utilized economically for the production of motor fuel is a difficult question to answer at the present. At any rate the total available will be considerably less than 140 trillion cubic feet. Some of it will be too sour, some too remote for economical gathering, some too near to centers of population requiring gas for industrial and domestic fuel. The picture is too hazy as yet to hazard a guess. If, however, we assume for purposes of comparison that our petroleum reserves are exhausted and that all of this gas will be converted into motor fuel by improved conversion processes, at the rate at which gasoline was consumed, say, in 1940, then these reserves would last conservatively about 15 - 20 years. This is just about the length of time that the experts predict that our oil reserves will last. So if you want to be somewhat optimistic about the conversion of natural gas reserves to motor fuel and slightly pessimistic about our oil reserves, then you could say that the possibility of converting our natural gas reserves to motor fuel just about doubles our potential motor fuel production capacity.

Such gross comparisons, however, are apt to be deceptive. Nobody is going to deliberately set out to build enough hydrocarbon synthesis plants to use up our reserve of natural gas in 15 - 20 years. Such processes, if successful in large scale operations, it is believed, will always be supplemental to some other major source of gasoline. An economic balance between the use of natural gas directly as a fuel and as a raw material for production of gasoline would ultimately be achieved. So, if these processes prove successful, it is believed that there is room for perhaps four or five large scale plants to operate continuously for a much longer period. When the time comes that our natural gas and oil reserves are both depleted, there are enough coal reserves to produce the United States' requirement in motor fuel on the 1940 level of consumption by way of improved conversion processes for the next two or three thousand years. True, the cost of converting coal is greater than the cost of converting natural gas but developments now under way in this country indicate that im-

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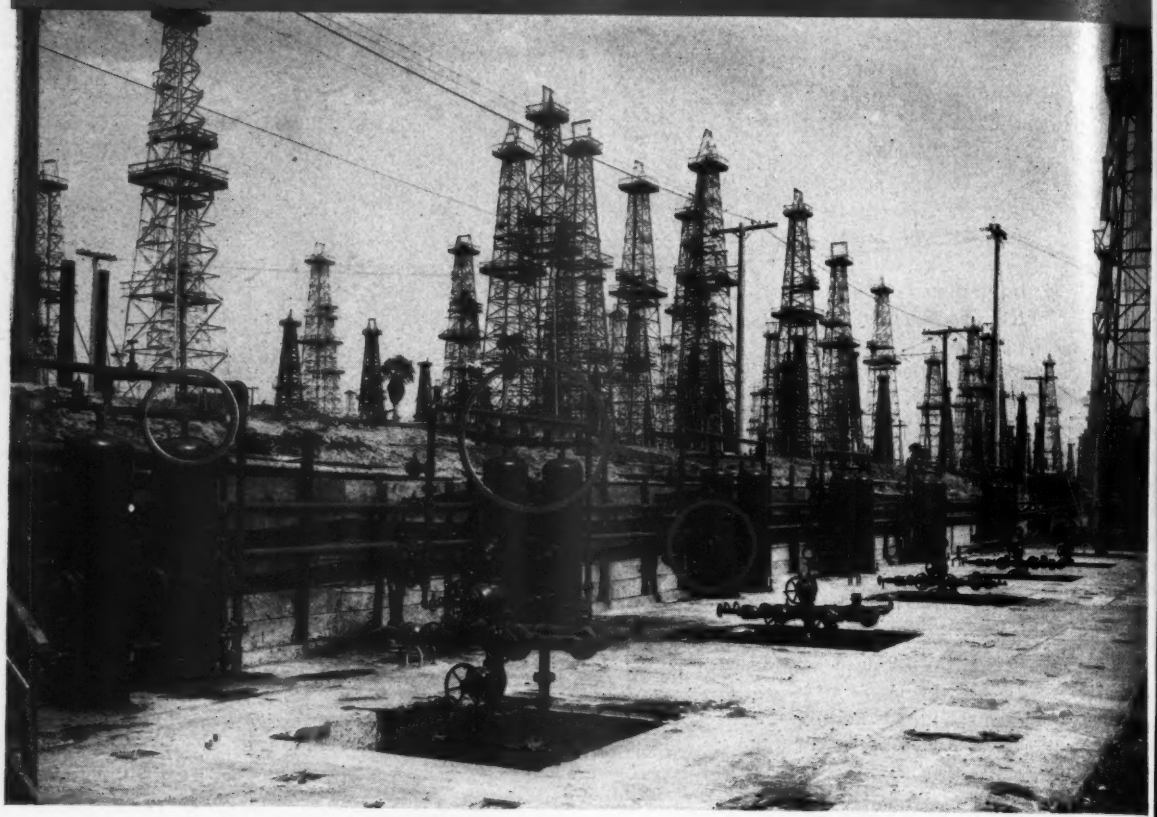

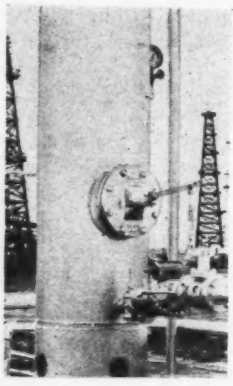

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provements in the method of producing synthesis gas from coal may reduce the cost to far below those for the German process.[9]

In Figure 5 the geographical distribution of our natural gas reserves are shown.[8] Since the amount of natural gas required for a synthetic fuel plant is so great, it is obvious that only a few locations, that is, those fields with large reserves, come into question. A 5000 B/D plant, for example, requires a total of 50 to 70 million CF of natural gas per day depending upon which published figures are used. Over a period of operation of 20 years this amounts to 365 billion to 510 billion CF. It is not improbable, however, that in the event that synthetic fuel plants prove successful, pipe lines will be laid for considerable distances to bring in gas requirements. The most important fields that come into consideration, as may be seen from the map are those of western Kansas, east Texas and south Texas and California.

To sum up the position of natural gas with respect to liquid hydrocarbon synthesis: natural gas will probably become a supplementary source of motor fuel in the near future and a modest number of plants will probably operate competitively with petroleum. Its use represents an intermediate but important process and as such has greater immediate interest than coal.

And now to leave the field of conjecture and to return to discussion of the very concrete developments in the conversion of natural gas to liquid fuels, which have given the process a real commercial significance.

Gas, similar to synthesis gas, but containing more hydrogen and less carbon monoxide, has been produced commercially from natural gas and steam in this country for quite a few years. This gas, which contains about 70 per cent hydrogen, 20 per cent carbon monoxide and 10 per cent of inerts such as carbon dioxide, nitrogen and residuel methane, is currently being used as a source of hydrogen in various industrial processes such as the synthetic ammonia and methanol processes and the hdyrogenation of petroleum stocks. The carbon monoxide is oxidized in a subsequent step to carbon dioxide which is scrubbed out leaving substantially pure hydrogen. The gas is produced in multi-tube gas fired reactors, each tube being about 3 inches in internal diameter and filled with nickel catalyst. These units operate at about 1600 F and, therefore, the tubes are made of expensive alloy steel. Tubes of small diameter are used in order to supply easily the heat required to maintain reaction temperatures, for the reaction is highly endothermic. This process can be modified to produce synthesis gas having a ratio of hydrogen to carbon monoxide of 2/1 by introducing carbon dioxide as well as steam and natural gas into the conversion unit. The combined reaction may be represented as the sum of two separate reactions as shown:

$$2\ CH_4 + 2H_2O \qquad 6H_2 + 2CO$$
$$CH_4 + CO_2 \qquad 2H_2 + 2CO$$

$$3\ CH_4 + 2H_2O + CO_2 \qquad 8H_2 + 4CO$$

This method of operation for synthesis gas production with multitube reactors is relatively costly but has found considerable commercial application where the final product sells, such as synthetic ammonia, for a fairly good price, or where the amount of gas required per unit of finished product is relatively small, such as in the case of hydrogenation of petroleum stocks. But for the process of producing motor fuel directly from such gas, in which case about 30,000 cubic feet of synthetic gas per barrel of product are required, the cost is high.

One alternative method for making synthesis gas which is now being used in pilot plant operation in this country depends on the use of pure oxygen. Before the war, the idea of using pure oxygen in large quantities for industrial purposes was wishful thinking. The cost was far too great. During the war, however, at least two improved low-temperature fractionation processes for obtaining oxygen from air were developed. The improvements are chiefly concerned with higher thermodynamic efficiencies in low pressure operation of adiabatic expansion engines. Used in conjunction with a synthetic fuel plant the cost of oxygen is now claimed to be as low as 5 cents per thousand cubic feet. This figure includes practically no power costs since sufficient power, as will be discussed later, is obtained by production of steam in the hydrocarbon synthesis step.

The production of synthesis gas from natural gas and oxygen can be represented by the following equation:

$$CH_4 + 1/2O_2 \longrightarrow CO + 2H_2$$

The theoretical amount of oxygen required is seen to be one-half the volume of methane. The reaction temperature is high, about 2100 F. But the reaction has one decided advantage over the carbon dioxide-steam-natural gas reaction previously mentioned, namely that it is exothermic instead of endothermic and, therefore, once the reactants

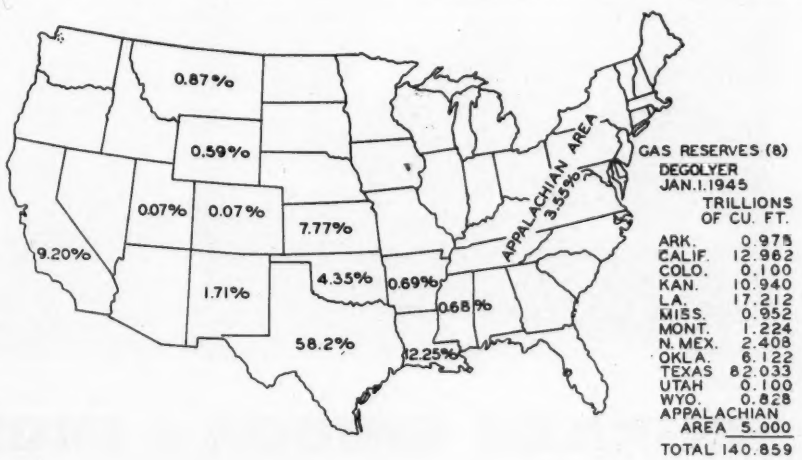


FIG. 5 DISTRIBUTION OF PROVEN NATURAL GAS RESERVES

South Coles Levee Cycling Plant

. . . . uses HORTONSPHERES and HORTON Flat-Bottom Tanks to store recovered petroleum products

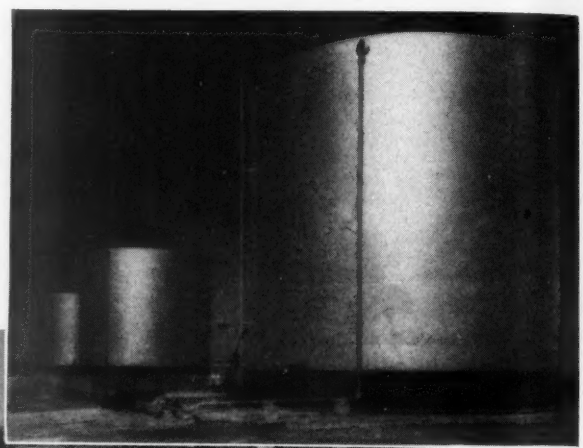
In cycling operations where wet gas from gas or oil wells is put through an absorption plant to recover propane, normal butane, isobutane, natural gasoline and other liquid petroleum products—adequate and dependable storage facilities are a part of the necessary equipment. Some of the products recovered may be stored in flat-bottom tanks while other products require pressure storage such as Hortonspheres. Storage facilities at the South Coles Levee Cycling plant near Bannister, California, include both types of tanks.

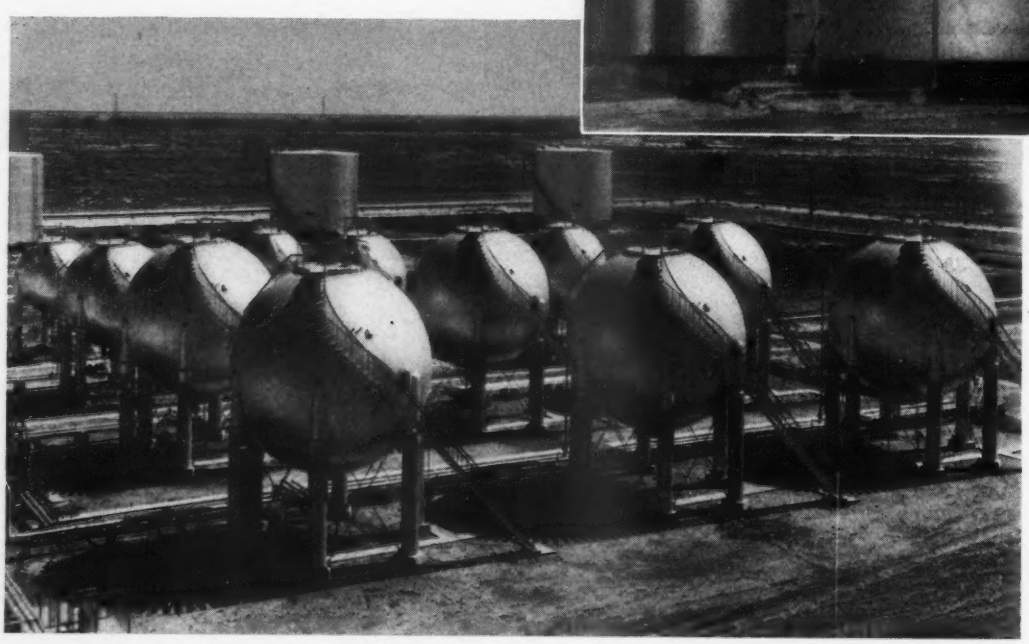
Hortonspheres are used to store volatile products that require pressures from 10 to 200 lbs. per sq. in. They protect their contents from evaporation loss and from fire. Their maintenance costs are low. Hortonspheres are built in accordance with API-ASME Specifications in standard capacities from 1,000 bbls. to 25,000 bbls.

When you require storage facilities for any kind of petroleum products write our nearest office for quotations on *Horton* tanks.

Right: These 10,000-bbl. Horton flat-bottom tanks are used to store crude oil at the South Coles Levee cycling plant near Bannister, California.

Below: This general view shows the three flat-bottom tanks and eleven Hortonspheres at the South Coles Levee plant. The three 1,800-bbl. Hortonspheres and the three 1,000-bbl. Hortonspheres were designed for 125 lbs. per sq. in. pressure, the two 500-bbl. Hortonspheres were designed for 250 lbs. per sq. in. and the three 2,000-bbl. Hortonspheres designed for 50 lbs. pressure.





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Houston 1.....5600 Clinton Drive	Chicago 4.....McCormick Building	Washington 4.....703 Atlantic Building
Tulsa 3.....1404 Hunt Building	New York 6.....165 Broadway Building	Detroit 26.....Lafayette Building

re preheated to temperatures considerably below reaction temperature, the reaction commences and supplies its own heat to bring the temperature up. Small diameter reaction tubes are not necessary in this process; the reaction proceeds in specially designed large diameter reactors. A nickel catalyst may be used, if desired, to promote the reaction, the reaction will take place without catalysts. The reaction may be conducted at atmospheric pressure or at higher pressures. It is desirable to operate at a pressure equal to that employed in the subsequent synthesis step (150-250 psi) in order to eliminate compression of the synthesis gas which is approximately twice the volume of the reactants. Natural gas can usually be supplied from pressure distillate operations without the necessity for compression. This leaves only the oxygen which must be compressed as it comes from the low temperature unit at approximately atmospheric pressure.

Although there is not much information available for publication at present on other cheap processes for the production of synthesis gas, the method involving the use of carbon dioxide, steam and methane as previously mentioned certainly has not reached its ultimate stage of development. The improvement to be anticipated here is to carry on the reaction in large diameter reactors instead of in multi-tube reactors with provisions for overcoming the endothermic nature of the reaction.

The other major improvement made on the process in this country is also indirectly a war-baby. It involves the use of a fluid catalyst in the synthesis of hydrocarbons from synthesis or water gas. The use of fluid catalysts was developed on a tremendous scale during the war in conjunction with petroleum cracking. The fluid catalyst technique has been described many times in the literature. Essentially it consists in introducing the gaseous or vaporized feed into the bottom of the reaction chamber filled with catalyst sufficiently fine to be suspended or fluidized in the vapor stream. The reaction takes place in the swirling, turbulent mixture

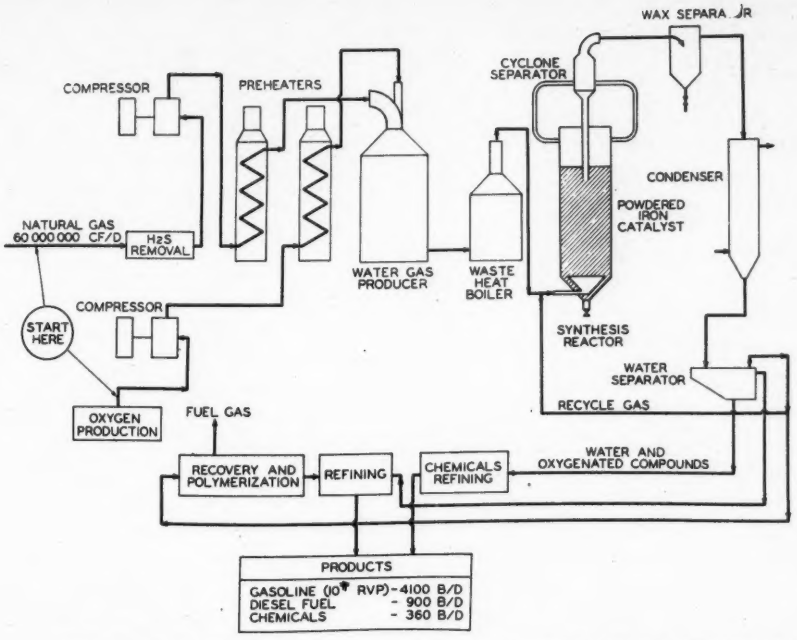

FIG. 6 FLOW DIAGRAM OF THE CONVERSION OF NATURAL GAS TO MOTOR FUEL

of catalyst powder, products and reactants. Catalyst dust is removed from the gaseous effluent by cyclone separators in the top of the reactor. Electrical precipitators are frequently used beyond this point to remove the last, persistent traces of dust. If the catalyst requires regeneration, it may be removed from the reactor continuously and carried by the regeneration gas into a regenerator working on the same principle as the reactor. If the catalyst does not require frequent reactivations, it is allowed to remain in the reactor indefinitely and such a process is commonly referred to as fluidized fixed bed operation.

Although there is still room for improvements and possibilities in fixed bed operation, for the synthesis of hydrocarbons from water gas, fluid-type operation has special significance. In the first place, the finely divided catalyst presents a greater amount of easily accessible surface. Thus the reaction proceeds faster. For example, in the standard German type of operation with granular or pelleted catalyst the space velocities in volumes of fresh feed per volume of catalyst per hour vary from about 100 to 250 whereas in fluid type operation with iron catalysts space velocities between 2000 and 3000 may be used.

Secondly, the use of fluid catalysts simplifies the problem of heat removal. We have mentioned previously the very high heat of reaction which attends the formation of hydrocarbons from water gas. The average reaction heat amounts to about 7000 BTU per pound of product formed.

In conventional fixed bed reaction using granular or pelleted catalyst, the maximum allowable distance of separation between catalyst and cooling surface for efficient heat removal lies between ⅜ and ¼ inch. Furthermore, the cooling surface in this case must be within a few degrees of the reaction temperature in order to prevent the existance of temperature gradients across the bed. In fluid operation not only is the allowable reaction rate 10-20 fold greater than in fixed bed operation, but much greater distances of separation of catalyst from cooling surfaces may be used. The constant and violent motion of catalyst and gases maintains a uniform temperature within the reaction even at a large temperature differential between the cooling surface and catalyst.

Details of reactor design are not available for publication at the present time. Several designs look

promising. In general, it may be stated that the heat reaction will be dissipated either as sensible heat on the catalyst which may then be cooled by recirculation outside of the reaction zone or by the production of steam in water-cooled tubes extending vertically into the reaction zone.

Having described briefly the major improvements which American research has contributed to the original Fischer-Tropsch process, it might be well to piece them together into a simplified flow-diagram in order to illustrate how the process may work on a commercial scale. Looking at the diagram in Figure 6, desulfurized natural gas and oxygen are preheated separately and passed into a combustion reactor where synthesis gas consisting of two parts of hydrogen to one part of carbon monoxide is produced. The exit gas is cooled from about 2100 F down to 600 F in a waste heat boiler where a portion of the power requirements of the plant as steam is produced. The gas at about 600 F is now passed into the synthesis reactor where liquid hydrocarbon product is formed. Here the reaction occurs in the presence of powdered iron catalyst in a fluidized state. The reaction temperature is controlled by water cooled tubes extending into the reactor. Tremendous quantities of steam are thus produced for use as power throughout the plant. The plant as a whole is practically self-sufficient in power. The effluent gases and vapors, separated from catalyst particles pass in succession through a wax trap, condenser and accumulator. The product in the accumulator separates into a water phase and a hydrocarbon phase. The water phase is drawn off and oxygenated compounds, predominantly ethyl or more familiarly grain alhohol, removed. The hydrocarbon layer passes on to refining into diesel fuel and motor fuel. By mild refining such as treatment at relatively low temperature over bauxite the raw gasoline will have about a 75-80 octane number. The cetane number of the diesel fuel is over 50.

From 60 million cubic feet of natural gas the yield is estimated to be approximately 5000 barrels of total refined hydrocarbon product consisting of about 4100 barrels of motor fuel and 900 barrels of diesel fuel. These are average figures based on various reports in the literature. In addition, about 360 barrels of oxygenated products are produced chiefly grain alcohol.

There is no better way to show the significance of the American improvements than to give the estimated investment and production costs of the American and European processes. In Table II these comparisons are given.

TABLE II

Comparative Cost for Production of Liquid Fuels: European and American Processes 9, 10

	Investment cost/ bbl/day	Cost per gallon (including 10 per cent depreciation
European Process using coal	$7600	19.2 cents*
European Process using natural gas	$4750	8.8 cents+
American Process using natural gas	$2000-2500	Approx. 5.0 cents

*Coal at $2.75/ton.
+Natural gas at 5 cents per M cu. ft.

In conclusion, the engineering improvements which have been made on this process and which have contributed to its potential, large-scale success in this country, are:

(1) Improvements in synthesis gas production particularly the utilization of oxygen.

(2) The use of fluidized catalyst technique in the synthesis step, thus increasing throughputs and solving the problem of dissipation of the heat of reaction.

In addition, this country possesses certain economic advantages favorable to this process:

(1) Large natural gas reserves which are more suitable at present than coal as a raw material.

(2) The larger scale operations, justifiable in the American economy, which results in savings from the use of manufacturing facilities of larger capacity.

As for the future of plants for conversion of natural gas to liquid fuels, there is every reason to believe that within the next five years several commercial units will be in operation. Being a new process, many unanticipated difficulties will be encountered during the initial months of operation of these plants but none of these difficulties are expected to be insurmountable. Further improvements, particularly with respect to yields of liquid hydrocarbon products, undoubtedly will be made, reducing the quantity of natural gas required per gallon of product. In the meantime, one can also expect further improvements in the use of coal in this process, so that in the next ten years or so it may become competitive too.

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Normal hexane, a petroleum hydrocarbon compound made as a gasoline byproduct, is widely used for the extraction of soybean oil.

Under agreement with the Chinese government, four American oil experts are in that country to study the possibility of increasing crude production and expanding Chinese refining facilities.

If the predictions of the petroleum industry's automotive scientists are correct, within a decade practically all motor fuels and motor lubricants—although made from petroleum—will be synthetics.

A.I.M.M.E. Los Angeles Technical Meeting Draws Record Attendance

With a record attendance of 300 delegates, the Petroleum and Industrial Minerals Divisions of the American Institute of Mining and Metallurgical Engineers held a Technical Meeting October 24 and 25 at the Los Angeles Ambassador Hotel. W. S. Eggleston and Norris Johnston presided as chairmen over the morning and afternoon sessions of the first day; while W. Templaar-Leitz and Albert W. Gentry presided over the morning and afternoon sessions of the second day.

The meeting drew engineers from the California oil fields and mining centers of the Southwest for their annual exchange of new developments and renewal of friendships. The petroleum meeting was arranged by the Pacific Petroleum Chapter, which consists of the Pacific members of the Petroleum Division of the Institute. The Industrial Minerals papers were arranged by the Western Committee of the Division.

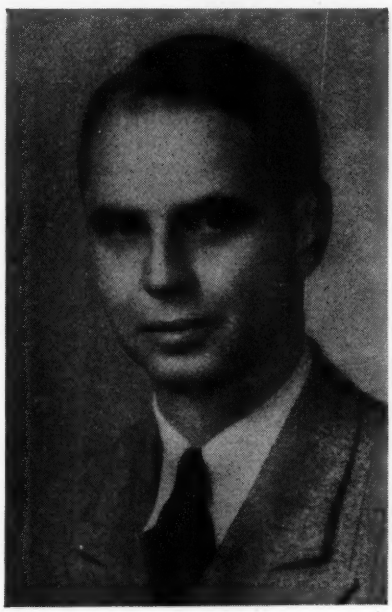
Banquet Addressed by L. C. Cates and Harvey Mudd

The two-day technical and business sessions were followed by a banquet on the evening of the second day, at which Mr. Louis C. Cates, president of the Phelps-Dodge Corporation and 1946 president of the Institute, spoke on **Foreign Trade Relations.** He also presented medals and diplomas of the Institute's Legion of Honor, significant of fifty years of membership, to Messrs. T. H. Aldrich, Jr., John Gross, and Meade Goodloe—all of Los Angeles.

Mr. Harvey Mudd also addressed the evening meeting on **Recent Observations in Europe and the Island of Cyprus.** He recently returned from these areas. In addition to Mr. Cates, other national officers were present for the gathering. Among them were A. B. Parsons, Secretary; H. F. Beardmore, Chairman Petroleum Division; and W. H. Strang, Executive Secretary, Petroleum Division.

DRESBACH AND WEAVER ON GEOPHYSICAL PROSPECTING

C. H. Dresbach, Western Gulf Oil Co., Los Angeles, and Paul Weaver, Gulf Oil Corp., Houston, Texas, gave a review of geophysical prospecting methods, devices and procedures. The paper presented a review of the trends in geophysical objectives, territorial and qualitative, with a somewhat detailed review of Gulf Coast and California exploration. Geographic factors, general geologic factors, and sedimentary factors were reviewed.



W. W. Porter II
Chairman of the Pacific Chapter Petroleum Division

Pacific Coast Geophysical Prospecting

The Pacific Coast Territory was defined as the states of California, Oregon and Washington, and totaling some 325,000 square miles. Despite this very large area, the authors stated, commercial production is confined to relatively small portions of California. The Los Angeles-Ventura area was estimated to approximate 3,000 square miles; the Santa Barbara area about 1,000 square miles; the San Joaquin Valley roughly 7,000 square miles; with the gas productive area comprising the north end of the San Joaquin and the contiguous Sacramento Valley adding another 6,000 square miles for a total of roughly 17,000 square miles.

It was pointed out that the figures indicate that only 5% of the total area of the three Pacific States has been shown to be potentially productive. Productive formations were described as ranging in age from Pliocene through the Eocene, with the Cretaceous to date having yielded only minor showings in oil and relatively limited gas production in the northern San Joaquin and Sacramento Valleys.

Pacific Coast Geophysical Prospecting Disappointing

The greater portion of exploration effort was described as being concentrated in the established petroliferous areas. Considerable prospecting and drilling in other areas were viewed as having yielded little or no return for the efforts.

Within the last three years, the authors revealed, gravity and seismograph exploration in the Imperial Valley was conducted by some of the major oil companies. Drilling on the resultant geophysical pictures showed little in the section tested besides some 12,000 feet of recent silts. The Salinas Valley was mentioned as having been prospected, and with a little recent drilling. The Washington-Oregon territory was described as having received the attention of an average of three seismograph parties during the past three years. Tests drilled by both major and independents to date were summarized as negative.

Opinions on the petroleum potentialities of the Washington-Oregon area were mentioned as differing widely. Some authorities, the authors said, hold that the predominantly continental section, the extensive flows and various igneous occurrences eliminate this area; while others are backing their opinions that there is a sufficient marine section to justify further exploration.

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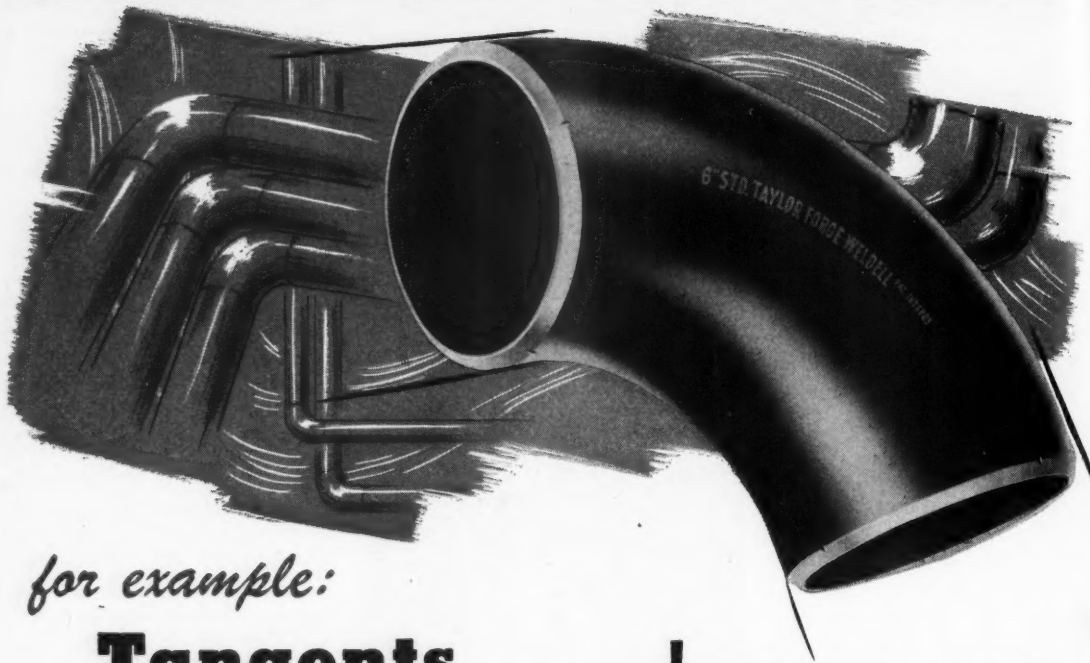

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California Geophysical Discoveries

The Buena Vista Lake gas field, about 25 miles southwest of Bakersfield, was described as being the first seismograph discovery in the San Joaquin Valley. It was first drilled in 1934. The closely associated deep Paloma condensate-black oil field is mentioned as not found until 1939 as the result of a detailed seismic program. The first oil discovery due to the seismograph was described as the Ten Section field, located about 10 miles southwest of Bakersfield, and found in 1936. Other major seismograph discoveries in the San Joaquin Valley were given as Coles Levee, Greeley, Rio Bravo, Strand, Canal, Helm, Riverdale, and Raisin City. The small Wasco field, producing from the Miocene at depths of over 13,000 feet, was stated to have been found from a detailed seismic mapping of deep reflecting horizons.

Gas Discoveries

The authors pointed out that particularly in recent years the gas discoveries of the Sacramento and northern San Joaquin Valleys have been due to seismograph work. The Rio Vista gas field, discovered in 1936, produces from the Eocene and is one of the great gas reserves in the U. S.

Geophysical Prospecting Increasingly Difficult

The great majority of the above named fields, the authors said, are generally regular anticlinal structures well out in the center of the sedimentary basins. While faulting has affected some of these earlier discoveries, it is generally a secondary feature, they said. Like various other areas that have received intensive drilling campaigns the present exploration objectives were described as of necessity becoming searches for obscure and complicated features, often of a combined structural - stratographic character. Further delineation and extensions of the extensive faulting found around much of the periphery of the San Joaquin Valley are sought in increasingly difficult exploration programs.

Complicating Factors

Two factors described as complicating seismic exploration beyond that encountered in most other areas are very strong velocity gradients and steep dips. These effects were given to be usually strongly accentuated in the flanking portions of the central part of the valley in which areas an increasing percentage of the exploration activities are being pursued.

Basement Schist Production

An interesting and increasingly important type of production was described as that recently secured from the basement schist, or conglomerate immediately overlying the basement schist, at the old Edison and Wilmington fields and from the new Gardena area located about 15 miles southwest of Los Angeles. The authors observed that while these discoveries have been due to deeper drilling and/or subsurface mapping, the presence of basement highs increases interest in the possibilities of geophysical studies in the search for additional prospects.

T. A. Atkinson
Vice-chairman for Petroleum, Southern California Section

Greater Attention Paid Obscure Prospects

The authors illustrated the increasing attack upon the more obscure prospects as the increasing number of crew months recently devoted to the Los Angeles, Ventura, and Santa Barara basins. Areally small and complicated prospects will normally be the objectives and in many cases stratographic variations will play at least a pertinent, if not a controlled, part. Such prospects the authors concluded, present a tough challenge and call for the highest type of combined geological-geophysical studies.

D'ARCY ON HYDRAULIC DRIVES

Nicholas A. D'Arcy, Jr. presented a paper on hydraulic drives in oil fields. Hydraulic drives were described as being classed into three general groups; 1) hydraulic couplings, where output speed and torque requirements are fairly uniform; 2) hydraulic torque converters, where speed and torque requirements vary; and 3) positive displacement fluid pumps and motors for small installations to eliminate complicated shafting and drives.

Hydraulic drives, the author stated, have been used successfully in every phase of the oil industry, from geophysical drill rigs to refinery operations, and new uses are constantly being developed.

Principles of Hydro-Kinetic Drives

Both the hydraulic torque converter and the hydraulic coupling were explained to be closed-circuit hydraulic units consisting of a pump or impeller on the driving end and a reaction member on the driven end. The rotation of the impeller imparts kinetic energy to the fluid in the closed circuit and drives the fluid to the outer periphery of the unit. The turbine member then absorbs the kinetic energy of the fluid in its blades and the fluid, having lost its velocity, is returned to the central portion of the unit. The impeller again picks up the fluid and the cycle is repeated.

Hydraulic Couplings

Hydraulic couplings used in the oil industry were described as falling into two general classifications, the traction or filled-type coupling and the scoop type coupling. The filled coupling is the simplest and most inexpensive unit, the author explained, and dissipates any heat developed through slippage by radiation to the air through the skin of the coupling. This limited ability to dissipate heat will ordinarily confine the coupling to those installations where there is less than ten percent slip.

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The scoop tube coupling was described as having two additional features. The fluid in the coupling is constantly circulated through an exterior heat exchanger or cooler and, when the cooler is of sufficient capacity, the scoop tube coupling can be run for long periods of time at any desired slippage up to and including 100%.

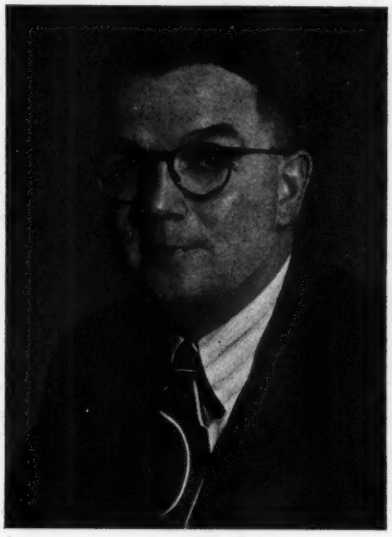
Applications of Hydraulic Couplings

The most widespread application of hydraulic couplings in the oil industry, it was stated, has been in connection with slush pump drives. In order to satisfactorily utilize a hydraulic coupling in connection with the slush pump, provisions must be made for cooling the fluids in periods of excessive slip. For this reason the scoop tube coupling is employed. The installation of a suitable hydraulic coupling allows the operator to maintain an efficient engine speed regardless of the speed of the slush pump. On surface hole the engine will operate at its most efficient speed and the coupling will transmit the power with between three and five percent slip, producing the maximum desired slush pump speed. As the hole deepens, the author said, either the circulating pressure will be increased or the volume must be decreased. The engine speed can be maintained constant with the hydraulic coupling in the drive. The hydraulic coupling, it was explained, transmits engine torque at a 1-1 ratio, therefore the slush pump pressure remains constant.

Traction Hydraulic Couplings

Traction or filled hydraulic couplings have been used successfully in geophysical drill rigs, grease mixers, belt conveyors, and on oil well pumping installations, he said. One of the latest geophysical drill rigs is powered by two Ford V-8 engines, one of which is located under the truck hood and the other mounted on the truck bed. The engine mounted on the truck bed drives through a hydraulic coupling to the slush pump.

One of the most interesting applications of the traction type hydraulic coupling was described as being in connection with an oil field pumping installation. It was explained that this type of installation is still in the experimental stage and there are still mechanical problems to be worked out before it will make a satisfactory installation for universal application. The initial tests were described as having proven that the internal combustion engine operation is greatly improved when a hydraulic coupling is installed as the power take-off of the engine.



A. C. Rubel
Delivered a paper on "What Management Expects From Engineers."

Limitations of Hydraulic Couplings

Hydraulic couplings were described as best fitted for those drives in which the prime mover is operating at a uniform speed over long periods of time and where the output speed and torque are fairly constant. Couplings were declared to be not suitable for operating at various input speeds or on loads where torque requirements change rapidly. An examination of the typical performance curve of a hydraulic coupling driven by an electric motor, the author stated, shows that the coupling output speed stalls under full torque at about ¾ of the normal prime mover speed. This, he said, prevents using the coupling at reduced prime mover speeds.

Hydraulic Torque Converters

The most popular application of hydraulic torque converters in the oil industry was described as being in connection with draw works and production hoists and satisfactory installation have been made upon sand reels, slush pumps, special service pumps and cementing pumps.

WATTS ON D-7 ZONE PRESSURES IN VENTURA FIELD

E. V. Watts, production engineer, General Petroleum Corporation, delivered a paper which considered some aspects of high pressures in the D-7 zone of the Ventura Avenue field. The D-7 zone of this field was described as of special interest because the initial reservoir pressure at 9200 feet nearly equalled the pressure exerted by the overburden. While the phenomenon has been observed elsewhere in the world, there is no previous case in California on record, the author said. Such high pressures, he explained, have been attributed to the sealing of the reservoir, followed by the emergence of the beds or by compaction of the sediments in various ways. Oil in the D-7 zone is undersaturated. At pressures above the bubble point, it was explained, oil is recovered by the slight expansibility of the reservoir framework and its liquid contents. Over 40% as much oil will probably be recovered by this mechanism, it was stated, as will be recovered by internal gas drives after pressures pass below the bubble point. Operations are handicapped by sand and pipe troubles.

Structure of Field

The Ventura anticline is a prominent feature of the Ventura Basin, being traceable on the surface about 17 miles. The Ventura Avenue field is located at the apex of the anticline. It is described as about one mile wide and five miles long, the major axis lying in an east-west direction. The productive limits cover an area of about 2300 acres. The entire anticline has been severely folded and faulted, it was explained, and the productive portions in particular are broken up by three major thrust faults having a general east-west strike.

Wells penetrating a fault may duplicate over 1000 feet of formation. The location of water is irregular and unpredictable. A few intermediate waters exist, while some strata have over 2000 feet of productive closures.

The principle oil accumulations were described as being below 3000 feet subsea. All sediments penetrated to date were given as consisting

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of alternating sands and shales of Pliocene age. The surface beds are of the Pico formation. The depth to the top of the Miocene is unknown, it was stated, but may be more than 500 feet below any well drilled to date.

In considering the original pressure-depth relationship for the Ventura field, the author points out that 7000 to 9500 feet is a region of rapid transition from pressures several hundred pounds in excess of hydrostatic to pressures several hundred pounds less than geostatic. The hydrostatic gradient was stated to be considered to be 0.44 psi per foot, while the geostatic gradient is placed at the commonly accepted 1.0 psi per foot.

Reservoir Behaviour

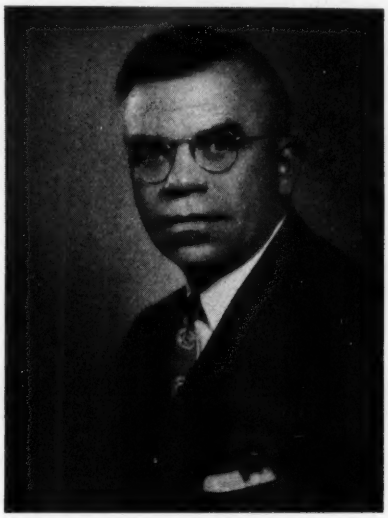
Older zones in the Ventura field were described as characterized by dissolved gas drive, or depletion type recovery. Little natural water encroachment is evidenced. Since it is likely that the D-7 zone is sealed in the vicinity of the field, the author observed, the chances for a water drive seem even more remote.

The bubble point pressure in the D-7 zone is estimated to be 3500 psi. Between the initial pressure and the bubble point it was stated, oil can be recovered only by virtue of the slight expansibility of the reservoir and its liquid contents. Contrary to general opinion, it was explained, this phase of the recovery process is a significant portion of the total. If the experience in the older zones is any criterion, the author said, the D-7 may be ultimately depleted to a gas saturation of about 22%. Using 17% porosity, 40% interstital water, 1.45 bubble point formation volume factor, and 1.15 final formation volume factor, the gas expansion recovery is calculated to be 110 bbls. of tank oil per acre-foot of productive sand.

Well Behaviour

The permeability to air of the D-7 sands is generally low, ranging up to several hundred millidarcies, but averaging less than fifty millidarcies. Productivity indexes of wells penetrating the entire zone — about 1000 feet—are usually less than 0.5 b/d per psi.

Since nearly all of the wells, it was explained, have bottom hole pressures in excess of the bubble point, gas-oil ratios are steady at the solution value of 900 cubic feet per barrel. In the absence of free gas in the formation, the relative permeability to oil is sensibly constant; productivity indexes therefore have not declined with time. While the indexes might be expected to increase slightly because of a decrease in oil viscosity with pressure, no systematic variation has been observed, the author said, possibly due to inaccuracies inherent in the testing procedure.



Ernest K. Parks
Presented paper on "What Engineers Expect From Management."

While the so-called mobility ratio, or ratio of permeability to viscosity is described as below the average for California fields, the condition is stated as being offset by the high pressure gradients which can be developed. Thus relatively wide spacing can be relied upon to deplete the reservoir almost to the bubble point. Thereafter, it was stated, closer spacing is probably desirable. However, by deferring drilling until the less expensive are actually needed, attractive economies result.

KILKENNY ON INTERPRETATION OF RADIOACTIVITY WELL LOGS

J E. Kilkenny, Chanslor-Canfield Midway Oil Co., presented a paper on the geological interpretation of radioactive well logs.

The author explained that among the igneous rocks the high radioactive values are found in the acid types, such as leucite and nepheline syenites and acid granites. Conversely, the basic rocks, such as basalt, peridotite, etc., are low in radioactivity.

Among the sedimentary rocks the brown, organic shales stand out with high values. Rhyolitic ashes and bentonites, especially if young in origin, have even higher values. Clean sands have very low values as do limestones and barren silts and shales.

The reason for the high radioactive value of brown organic, shales has been the subject of much speculation, thought and research. Apparently organic matter, in itself, is not the contributing factor because coal is very low in radioactivity. The fineness of the grain size, likewise is no criterion because barren shales do not have high values.

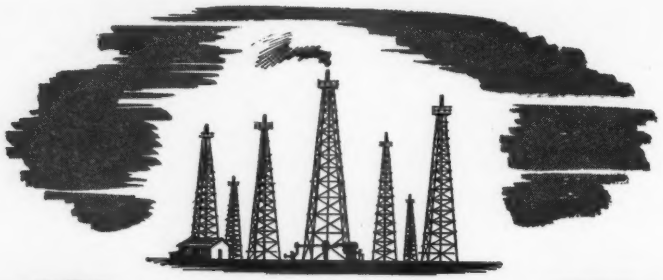
Radioactive Well Logging Mechanism

It was explained that the measurement of Gamma Ray intensities is accomplished by means of an ionization chamber about three feet long that contains two insulated electrodes. The chamber is filled with inert gas under high pressure. When lowered into the well, bombardment of the gas chamber by Gamma rays emitted from the rocks causes ionization of the gas and a resultant flow of electricity between the electrodes. This flow is relayed through a cable to the recording truck where it is recorded on paper.

The Neutron curve is obtained through the use of the same instrument mentioned above, but with the addition of a neutron source shielded from the ionization chamber. The neutrons bombard the formation, stimulating radioactivity which is recorded by the ionization chamber. If the formation contains hydrogen in the form of water or oil, there is a dampening effect so that a dense limestone records a higher value than a porous fluid-bearing sandstone.

Radioactivity Correlations in San Joaquin Valley

Bentonite and ash markers, the author explained, show up as long, sharp kicks on the radioactivity log where they may not show at all on electric logs. This is important in



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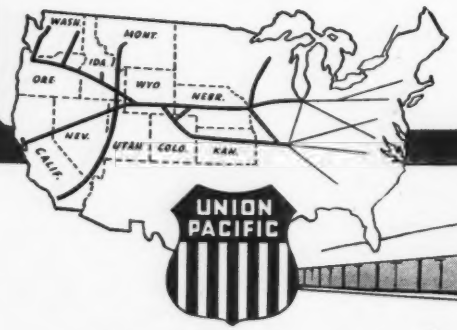

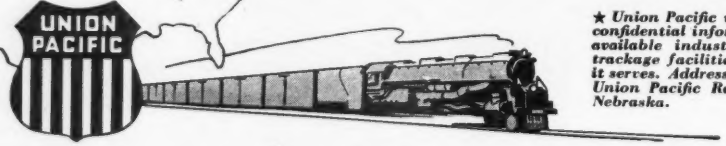

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sections where continental beds prevail, such as the Zilch formation in the Helm Field and the Kern River Series at Edison.

Sporbo and phosphatic nodules are radioactive and show up in the basal Etchegoin beds in the Cymric Field logs.

Some of the brown, organic shales in the San Joaquin Valley, such as the Kreyenhagen shale in the Coalinga and Helm Fields, do not show high radioactive values. This may be due to the derivation of the shale from Franciscan rocks, composed of basalt and serpentine, on the west side of the Valley.

Radioactive well logs have the special advantage of being able to log cased wells and may be used to make correlations in old wells drilled before the days of electric logging and coring.

Also, wells with a predominent continental section may be correlated with radioactive logs where other methods are unsuccessful.

The author concludes that there is room for better and more accurate interpretation of meaning between the kicks on the log. This may be accomplished by more detailed study of the radioactive values in geological surface sections and the actual measurement of the values of different types of sediments in the laboratory. Work of this type has been done in the Mid-Continent area by Well-Surveys, Inc., but as far as known, very little has been done here in California.

MOYER ON WELL DRAINAGE AND ULTIMATE RECOVERY

Vaughn Moyer, Union Oil Co., Bakersfield, presented a paper dealing with some theoretical aspects of well drainage and economic ultimate recovery.

A method of studying reservoir behavior in which well-bore pressure drawdown effects are incorporated was presented. Examples were submitted indicating the use of this factor for the relating of sand thickness and permeability to economically producible reserves, determining the effect of well-bore permeability damage on economic ultimate recovery and productivity index, investigation of well-spacing in simple reservoirs, and for indicating the long-range variation of productivity index with rate. Because of the scope of factors considered, the paper did little more than touch on each problem, hence is qualitative in part. Each phase was but briefly considered, and the author feels should be reviewed in greater detail before further conclusions are made.

He recognized that the method outlined has definite limitations, both as to application and to interpretation, but believes it possible that further study may bring forth factors invalidating the above conclusions, or may show an improbability to exist in some of the assumptions made.

W. S. Eggleston
Chairman, Opening Session.

E. V. Watts
Addressed the meeting on "Some Aspects of High Pressure in the D-7 Zone, Ventura Field."

The author attempted to incorporate well pressure drawdown into reservoir history, and to re-evaluate previously considered factors, such as those involving recovery, well spacing, and productivity index, from the standpoint of permeability and drainage radius. By incorporation of drawdown into reservoir history, the author believes that theoretical considerations will more closely approximate actual reservoir behavior experienced in an oil field. For purposes of simplification, an internal gas drive type field, without primary gas cap, was selected for discussion.

Basic Data and Assumptions

Details of equilibrium saturation conditions for no drawdown production for various pressures in a reservoir, it was explained, are determinable by several methods which permit the construction of a curve of oil saturation vs pressure for any selected combination of initial interstitial water and hydrocarbon saturation. This curve is then a description of equilibrium saturation conditions at any given pressure in a reservoir.

Developing this, it was stated, details of saturation and flow permeability may thus be determined for any increment or portion of a well drainage area or reservoir. In this manner the effect of pressure differential (drawdown) may be incorporated into reservoir and well drainage considerations.

It was pointed out that this method thus makes use of no-drawdown equilibrium production data, superimposing a drawdown effect upon them. It also assumes that net flow conditions in any considered increment of reservoir are not materially altered by the entrance of fluids from other increments into them, but approach equilibrium for the existing pressure and saturation. (i.e., each increment behaving in a more or less independent fashion, dependent largely upon the equilibrium considerations mentioned above.)

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Development of Method

Actual solution of the problem of determining pressure and saturation gradients around a well producing at a pressure appreciably different from that existing in a reservoir, as considered in the paper, involved dividing the surrounding area into concentric rings, and approximating the flow conditions across each ring under the limitations described above. If each ring is considered as in a steady state condition, and the mass of oil flowing across it is taken to be a constant value, the relation between oil saturation, relative permeability and pressure for it can be outlined, and the pressure and saturation gradient calculated, although both vary continuously outward from the well bore, the author stated.

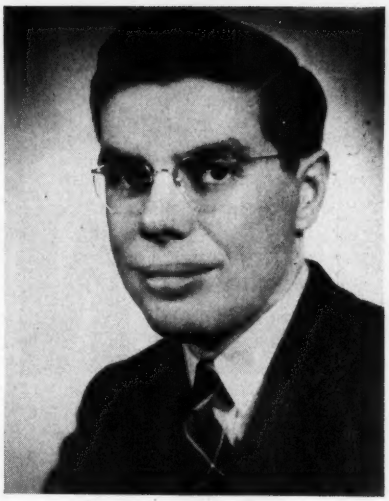
STANDING, LINDBLAD, AND PARSONS ON CYCLING RECOVERIES

M. B. Standing, E. N. Lindblad, and R. L. Parsons, Standard Oil Co. of California, La Habra, presented a paper dealing with the calculated recoveries by cycling from a retrograde reservoir of variable permeability. According to the authors, the results show that the recovery is greatest if the reservoir pressure is allowed to decline prior to cycling dry gas.

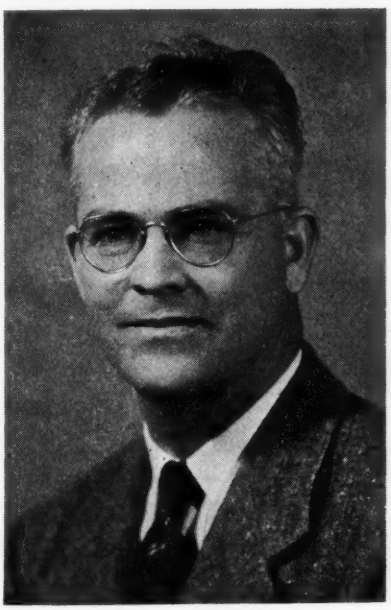
Pressure decline in gas-condensate type reservoirs, the authors explained, is accompanied by the formation of a liquid phase throughout the reservoir. Over the past ten years the processing of the material from these types of reservoirs for the heavier hydrocarbon components and the return of the light fractions to the reservoir ("cycling") has become increasingly popular. It has often been stated that the purpose of such a program is to prevent the loss of the retrograde liquid phase formed in the reservoir, they said.

The purpose of the paper was given to be the presentation of the results of laboratory tests and computations concerned with several possible methods of producing a gas cap or condensate type of reservoir.

The results, the authors declared, show that the recovery of heavier hydrocarbons from this type of reservoir is not a maximum under conditions of cycling at or near the dew point pressure. Instead, variations



Vaughn Moyer
Delivered paper on "Decrease in Ultimate Recovery Due to Lowering of Productivity Indices."



Nicholas A. D'Arcy, Jr.
Author of paper on "Hydraulic Couplings and Torque Converters As Applied to Drilling and Well Pulling Equipment."

in permeability and the ability of the dry injected gas to revaporize condensate were stated as pointing to cycling at a considerably reduced pressure as the optimum production method. In addition the authors suggest a way of evaluating sands for their permeability variation.

Calculations and Condensate Recovery Efficiency

The calculations presented in the paper were given in terms of the production of the butanes-and-heavier fraction from the gas cap of a field which had an original pressure of approximately 3000 PSI. The authors believe that the calculations indicate:

a. To what extent the condensate formed in the reservoir after pressure decline can be recovered by the cycling of a dry absorber plant gas through the sands.
b. Whether there would be greater recovery of hydrocarbons if cycling were instigated at the original reservoir pressure.

In answering the above points, three factors were taken to determine the efficiency with which condensate is recovered from a sand. These factors were given as:

1. The ability of the dry absorber gas to vaporize the condensate in the sand.
2. The effect of bypassing, within a swept out area, due to permeability variations in the sand.
3. The effect of well pattern on the volume of formation swept out by the injected gas.

Compositional and volumetric changes of reservoir gas and liquid phases during pressure decline and cycling, they explained, can be calculated from equilibrium constant data and the original composition of the reservoir material. However, in the case of condensate systems, the quantities of liquid phase so calculated were described as so intimately connected with the equilibrium constant of the heaviest components in the system, that it is desirable to have the results of PVT and other tests to guide the calculations.

Effect of By-Passing

With respect to the effect of bypassing, on a local scale, due to permeability variations, the actual variations were given as so complex and so largely unknown that attempts were not made to refine the calculating procedure unduly, or to consider whether the flow should be radial or linear or some more complicated form. Rather, the calculations were described as based on the simple supposition that the flow is linear through variable permeabilities in parallel.

(Continued on Page 71)

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Evaluation of Absorber Operating Efficiency

Summary

While it has been of invaluable aid to the industry, the conventional theoretical absorption tray analysis of Kremser and Brown presents a serious weakness in that its basic "tray efficiency" factor shifts markedly in value with percentage of key component recovered. Furthermore, the degree of this shifting varies widely for different columns, and for different conditions of operation of a given column. Since it is rarely possible to operate a commercial column under an exact pre-set condition of feed quality, column loading, and key component recovery, this shifting of the tray effiicency drastically limits the usefulness of the conventional analysis for accurate specification definition, or for precise column operation comparison.

The authors have recently analyzed the operating characteristics of some 40 commercial columns ranging in pressure from 30-lb. to 1800-lb. gauge. From this study they have developed a technique for evaluating absorber performance which utilizes an experimentally derived absorption factor chart in place of the classical Brown chart, and which gives promise of fully correcting the limitations of the conventional theoretical method.

* * *

To date almost all industry evaluations of absorber operating efficiencies have been based on the classical Absorption Factor Chart of Souders and Brown[1] (Fig. 1). This chart was developed from the original work of Kremser[2], and shows the relationship existing between percent component recovery, number of theoretical trays employed, and absorption factor "A", for an ideal absorber—i.e., an absorber wherein perfect equilibrium is achieved on each tray, and for which the values of oil and gas rate, temperature, and pressure, are constants throughout the column for any one given operation.

The absorption factor "A" of this chart can best be defined as:

> The ratio of the amount of a given component absorbed on a tray to the amount of that same component absorbed on the immediate tray above.

By mathematical analysis, Souders and Brown have shown that for the ideal column:

$$A = \frac{y_{n+1} - y_n}{y_n - y_{n-1}} = \frac{L}{V} \times \frac{1}{K}$$

where:

L = total moles of liquid flowing tween trays

V = total moles of gas flowing between trays

x = mole fraction of a component in the liquid

y = mole fraction of a component in the gas

$K = \frac{y}{x}$ = vapor-liquid equilibrium constant (a function of temperature and total pressure for each component)

n = number of plate, starting at top plate of absorber (when used as a subscript indicates plate of origin from which the liquid overflows or the vapor rises)

Although entirely theoretical in development, the Brown chart emphasizes an extremely vital operating characteristic of all absorbers, namely:

> Once a relatively small number of trays is provided, the use of additional trays in the column is materially effective over only a limited range of absorption factor values.

By
E. G. Ragatz, Consulting Engineer
and
J. A. Richardson, Process Engineer,
Bechtel Brothers McCone Company

October Meeting

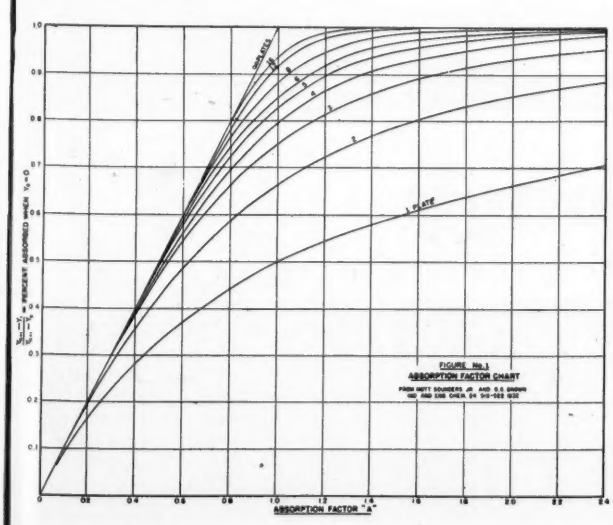

FIGURE No. 1
ABSORPTION FACTOR CHART

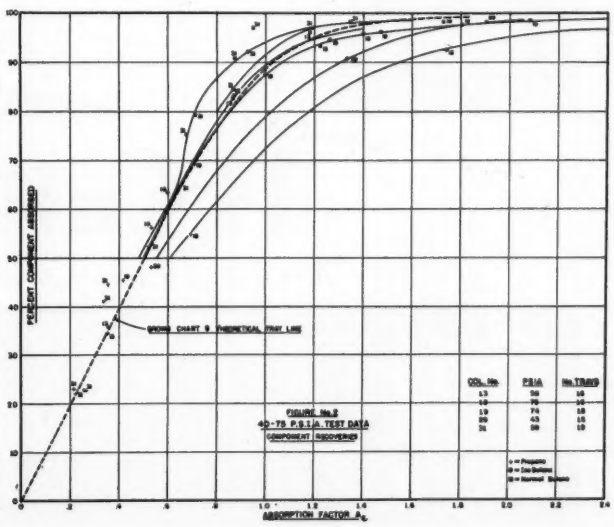

FIGURE No. 2
40-75 P.S.I.A. TEST DATA
COMPONENT RECOVERED

Worthmeyer's OIL COMPANY

INTER-OFFICE MEMO

FROM: Vice-President in Charge of Operations.

TO: Drilling Superintendent

At last report our gas-injection well x x x x was giving a lot of trouble, leaking in control head and around gates. Several attempts to kill the well, in order to make repairs, had failed. What is the situation now?

Worthmeyer's OIL COMPANY

INTER-OFFICE MEMO

FROM: Drilling Superintendent

TO: Vice-President in Charge of Operations.

Everything O.K.:--job finished this A.M.

As you know, this job was a tough one. Tubing pressure in this well is 2300 psi; casing pressure is 1900 psi. We found the tubing plugged at the bottom, so we couldn't circulate mud to kill the well. Gun perforating the tubing was the only answer, but we doubted it could be done; blowout preventer packing was so tight, because of the high pressure, that it seemed impossible to get a gun down the well.

But we called McCullough and they did the job. Ran in their 1¾" diameter sectional gun on a piano-wire measuring line through their own packing head, and shot 4 holes, ⅜" diameter, at 6700 feet, using their special deflecting bullet to avoid any possibility of casing damage.

Job completely successful. We killed the well without trouble, made repairs and now everything is O.K.*

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The reason for this limitation, of course, is inherit in the basic definition of Absorption Factor—since obviously, practical limits of recovery are reached with the use of only a few trays whenever the ratio of the amount of a given component absorbed on a tray to that absorbed on the tray above is substantially smaller, or larger, than 1.0.

For the narrow absorption factor range of some 0.8 to 2.0, however, both the number and absolute efficiency of the column trays are of exceeding importance, since it is over this range that the basic design of the column, with its accompanying oil circulation requirement, is developed. Effective handling of the commercial absorption column problem calls for the precise relating of the actual column trays employed with the lean oil rates and quality, column operating temperatures and pressure, and resultant key component recoveries, over this particular absorption factor range.

From its inception, the theoretical tray analysis recognized that the physical values of $\frac{L}{V}$ and K vary substantially through an actual column; that such variations correspondingly affect the true value of "A"; and that these variations increase rapidly with increasing pressure. However, it was long assumed that an effective or mean "A" factor could be developed which would average out these differences, and that through such a mean factor, the operation of an actual column could be directly related to a parallel-operating theoretical column.

If this assumption had proved correct, solution of the absorber problem would have been simple—since under such circumstances relative key component recoveries could have been accurately predicted by relating an appropriate "A" factor to its corresponding component recovery value through the proper theoretical tray line on the Brown chart. Furthermore, an exact measure of the operating efficiency of the actual column would have been expressed in the ratio of the number of trays required for the parallel-operating theoretical column to those utilized in the actual column.

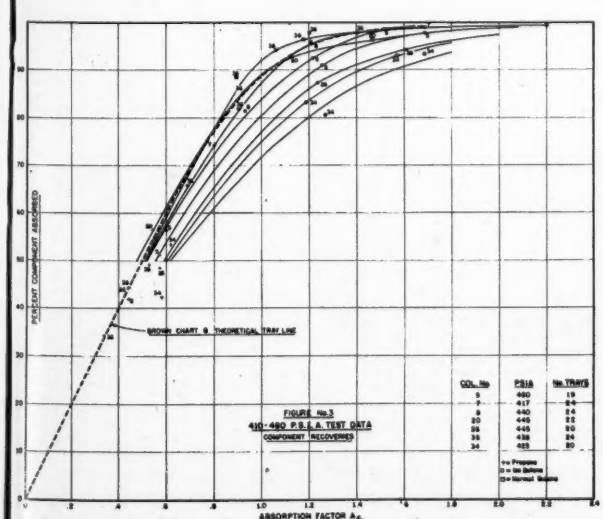
Unfortunately, experience has shown that no such simple relationship exists between an actual column operation and a parallel-operating theoretical unit. Instead, it has been found that the number of theoretical trays required to match the operation of an actual column shifts markedly with the percentage of key component recovered, and that the degree of this shifting varies widely for different columns.

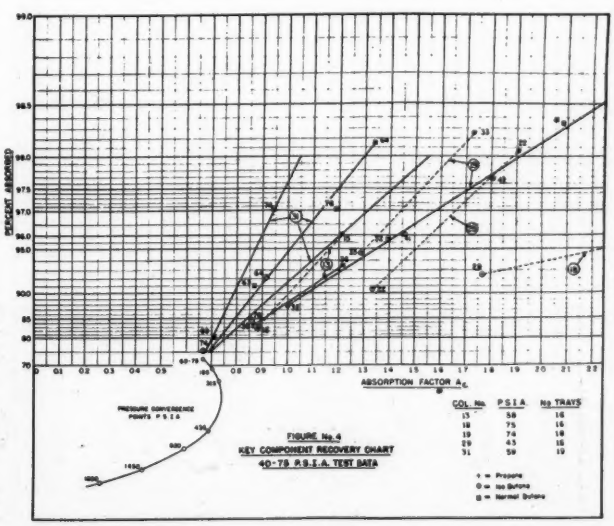
As a consequence, the conditions of operation of an actual column must be exactly specified (and met) if a theoretical tray efficiency factor is to be used for accurately measuring a column's relative operating effectiveness. Since it is rarely possible to operate a commercial column under such pre-designated operating conditions, the conventional theoretical "tray efficiency" method can rarely be used for accurate specification definition, or for precise operating column comparison.

In seeking an improvement on the conventional absorber evaluation method, the authors concluded that continued use of a mean absorption factor offered the best means for correlating the major variables associated with the absorber operation; that the embodiment of this factor in a relative component recovery chart offered the simplest approach to absorber efficiency evaluation; and that the key to the evaluation problem's solution lay in substituting correlating factors derived from actual operating data for the older theoretically calculated factors.

Following this line of reasoning, an intensive study was made of a large number of tests from some 40 different columns ranging in operating pressure from 35-lb. to 1800-lb. gauge. As a result of this study, an analytical method has been developed which gives promise of having the following desirable absorber evaluation characteristics:

1. Utilizes simple data readily obtainable from presently installed commercial columns.
2. Eliminates the need for exercise of personal judgment in analyzing these data.
3. Provides an automatic check on the consistency of the test-indicated key component recoveries.
4. Predicts relative key compo-


PERCENT COMPONENT ABSORBED
ABSORPTION FACTOR A_c
BROWN CHART 9 THEORETICAL TRAY LINE
COL. No | PSIA | No. TRAYS
FIGURE No. 3
410-480 P.S.I.A. TEST DATA
COMPONENT RECOVERIES



nent recoveries well within the accuracy required for precise engineering work.

5. Accurately establishes the operating efficiency of an absorber without the need of running on a precise quality of feed stock, or effecting a precise recovery of a given key component.

6. Is capable of accurate definition, and utilizes a simple number for final identification of the column's operating efficiency.

The first step of our operating data analysis required the selection of a sound basis for calculating the mean absorption factor. Fortunately, this particular task had already been adequately handled by Edmister[3] in his recent analysis of Horton and Franklin's[4] proposed absorption calculation method. Edmister's mean absorption factor is based on the "A" factors existing at the top and bottom of the column, and may be expressed as:

$$Ae = \sqrt{Ab\,(At+1)+0.25}-0.5$$

where:

A_E = Effective or mean absorption factor

A_B = Absorption factor at bottom tray conditions

A_T = Absorption factor at top tray conditions

$$A_n = \frac{L_n}{V_n}\,\frac{1}{K_n} = \text{Absorption factor at tray "n"}$$

While Edmister's original derivation assumed that K's based on the top tray temperature would be used for calculating the top plate absorption factor, we have used "K's" based on the temperature of the fat oil leaving the bottom of the column for calculating both the top and bottom "A" factors. Justification for this simplification lies both in the character of the temperature gradient existing through the average absorber, and the fact that it has proved thoroughly workable in practice.

Having decided on a method for determining A_E, component recoveries indicated by the test data were then calculated and plotted in the conventional manner on rectangular coordinate group-charts against appropriate A_E's — with each group chart being confined to a comparatively narrow operating pressure range. Figs. 2 and 3 are typical of these group plottings, and cover respectively 40-75 p.s.i.a. test data, and 410-480 p.s.i.a. test data. For comparison, we also plotted on these group charts the Brown curve for an eight-tray theoretical column.

Study of these group plots brought out the following pertinent points:

1. While the operating lines for the actual columns were of the same general nature as the theoretical tray lines, they departed materially from the theoretical in detail.

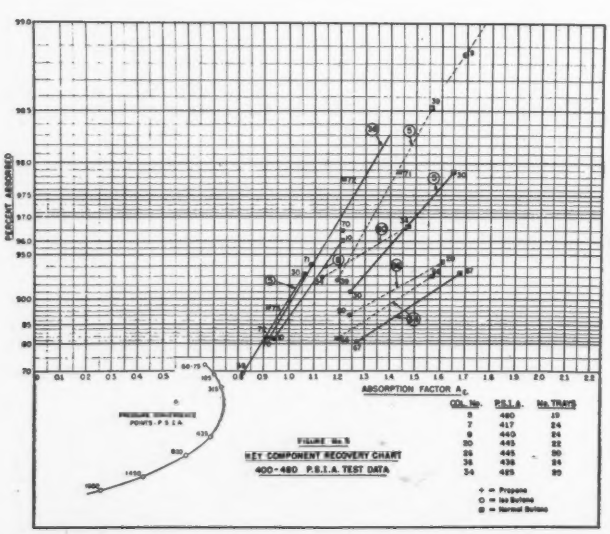
2. Individual test lines indicated marked column differences both in general tray effectiveness and relative component recoveries—with these differences often being evidenced by a crisscrossing of lines, rather than by a systematic line displacement as on the theoretical Brown chart.

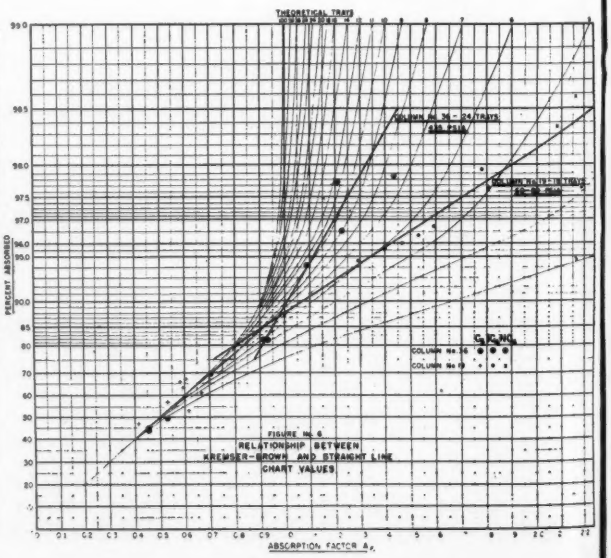
3. The rectangular plotted operating lines were difficult to interpolate accurately in the critical 75%—95% recovery range due to rapid curvature in this region.

4. While it was clearly evident that some of the column tests were much less authoritative than others, no reliable criteria of general operation pattern, or individual test consistency, was presented by the rectangular plots.

These facts clearly called for a more effective graphical treatment of the data, and led directly to the development of the special "straight-line" Key Component Recovery Chart upon which our new analytical procedure is based.

With this new chart, all component recoveries between 75% and 99% plot as a straight line for any given column as long as its basic tray efficiency remains constant. Furthermore, all such straight lines, irrespective of number of trays employed or degree of efficiency, can





be drawn through a single convergence point for any given absolute pressure with an accuracy well within that required for precise engineering work. Finally, the characteristic operating lines remain fixed for any given column over wide ranges of lean oil temperatures, and for all types of intercooled columns as long as the intercooling is confined to the upper 75% of the column.

These chart features stem from a special emporical scale construction —which scale, together with an associated group of pressure convergence points, was developed directly from actual operating data, and cannot be duplicated by any theoretical analysis of which we are cognizant.

Typical examples of the straight line chart's characteristics are presented in Figs. 4 and 5, on which we have plotted the same data previously presented in rectangular chart Figs. 2 and 3. Inspection of these latter plots shows that:

1. A majority of the operating lines on each plot can be drawn as straight lines through the indicated pressure convergence points with an accuracy well within that required for precise engineering practice.
2. Where there is a conflict in the test data, as between tests 33 and 32-41-42 of column 19, or tests 15 and 36 of column 13 (Fig. 4) the "single convergence point" criteria immediately tells which particular test recovery value is in error.
3. Where there are several well defined lines of different slope for a given column, such as shown by tests 69 and 74 versus 63 and 64 for column 31 on Fig. 4, or tests 38 versus 39 versus 30 for column 5 on Fig. 5, a fundamental difference in basic tray efficiency is indicated.
4. Operating lines which depart radically from the general operating pattern as with column 29 on Fig. 4, or column 20 on Fig. 5, definitely indicate serious error in the original test data.

Additional features of the straight line chart are presented in Fig. 6. Here we have plotted the operating line for column 19 from Fig. 4, and column 36 from Fig. 5, on a straight line chart to which has been added a grid indicating the "Brown percent yield versus A_E relationship" for three to one hundred theoretical trays. Also, the percent key component yields from 70% on down to 0% have been indicated. These particular chart additions were made for the purpose of demonstrating:

1. The wide changes in Kremser-Brown theoretical tray efficiency shown by a single column operating at a given basic tray efficiency as its percent recovery of key component is changed.
2. The marked difference in relationship existing between percent recovery and A_E for recoveries of over 75%, and under 60%.

The wide changes shown by the theoretical Kremser-Brown tray efficiencies of Fig. 6 are typical. Also, it should be noted that while twenty-four tray column 36 ranges through an **increasing** theoretical tray efficiency of 16.5% to 44.2% to 34.6% in going from a 75% to a 98.5% key component recovery, eighteen tray column 19 goes through a reverse, or **decreasing,** efficiency range of 100% + down to 25% for the same key component recovery change. The magnitude and reversed direction of these two sets of tray efficiencies aptly illustrate the inadaptability of the conventional theoretical tray efficiency factor to accurate specification definition, or precise column operation comparison.

While the test points for component recoveries below 70% on Fig. 6 are somewhat scattered, it is clearly evident that one single line will well represent the average of both column operations. This observation conforms with the well understood absorber relationship that in the actual commercial column, excess trays are always present for the "under 70% recoveries", and therefore such recoveries are functions of Absorption Factor only— and independent of actual tray number or tray efficiency.

We have previously mentioned the empirical nature of the pressure convergence points on the straight line chart. These points constitute an important feature of the chart, and their proper location is essential

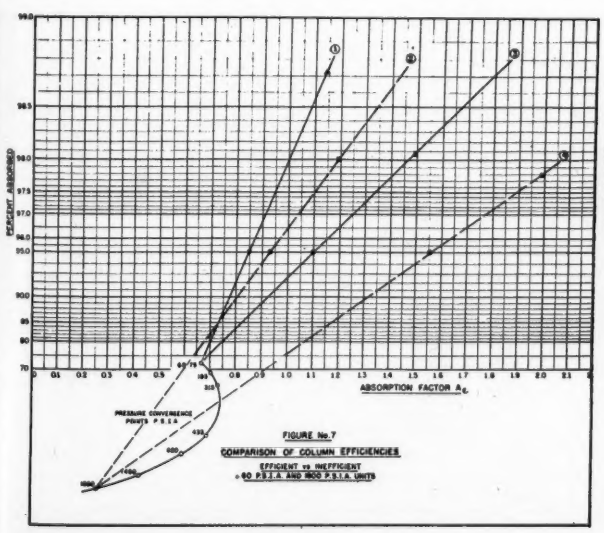


FIGURE No. 7
COMPARISON OF COLUMN EFFICIENCIES
EFFICIENT vs INEFFICIENT
- 40 P.S.I.A. AND 1800 P.S.I.A. UNITS

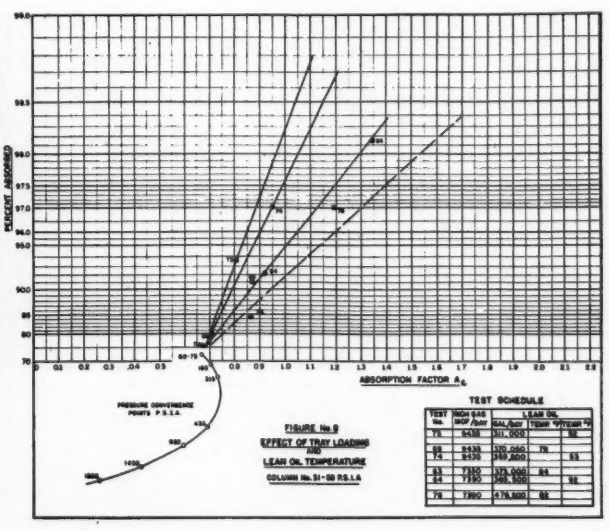


FIGURE No. 8
EFFECT OF TRAY LOADING AND LEAN OIL TEMPERATURE
COLUMN No. 31 - 50 P.S.I.A.

to the chart's accuracy. While the present indicated locus of such points has been defined by three fairly large groups of data (averaging 67.5 p.s.i.a., 435 p.s.i.a., and 1450 p.s.i.a. respectively,) and four smaller groups, there is some question as to the authority of a portion of this material. Consequently, we may find that the presently indicated convergence point locus will be subject to some change as additional authoritative data become available.

In connection with this locus, it will be noted that the individual pressure convergence points shift substantially with pressure. This shifting is in full agreement with another well understood absorption law, namely, that the absorption column's relative selectivity steadily decreases with increased pressure.

On Fig. 7 we have illustrated the operation of this law as applied to a pair of low and high pressure columns. In this figure, lines 1 and 2 represent two high efficiency units operating at 60 p.s.i.a. and 1800 p.s.i.a., respectively, while lines 3 and 4 represent two similar pressured low efficiency units. For such pairs of columns (with each pair operating on the same quality lean oil and rich gas) the percent nC_4 recoveries and relative lean oil rates associated with a common 90% iC_4 recovery, are indicated on the following table:

Relative Oil Rates and nC_4 Recoveries @ 90% iC_4 Recovery

	Pct. nC_4 Recovery	Relative Oil Rate
60 p.s.i.a. Efficient Column	98.71	100%
60 p.s.i.a. Inefficient Column	98.07	130%
1800 p.s.i.a. Efficient Column	98.00	100%
1800 p.s.i.a. Inefficient Column	97.80	170%

These figures not only indicate the differences in relative selectivity existing between high and low pressure columns, but also emphasize the importance to oil circulation of employing high efficiency column equipment—particularly for the higher pressure operations.

The effect on the straight line operating curves of materially changing the lean oil temperature or tray loading at a given column is shown on Fig. 8. Inspection of this figure (covering the operation of a 59 p.s.i.a. column) shows that the basic tray efficiency as measured by the slope of the operating line remained fixed for wide changes in lean oil temperature as long as the tray's physical loads were held substantially constant. On the other hand ,substantial changes in the physical loading of the column resulted in corresponding changes in its basic tray efficiency.

In this clean-cut distinguishing between changes in physical tray action, and changes in lean oil temperature, the straight line chart thoroughly reflects good theory.

Fig. 9 reveals the effectiveness with which the straight line chart handles the intercooled absorber operation. For this particular test series the lean oil and rich gas rates were held substantially constant, while the number and location of active oil coolers were changed. As shown on the chart, this control resulted in a single operating line for those four tests which utilized coolers in the top 75% of the column. For the fifth test (No. 204) wherein cooling was employed near the bottom of the column, a second, less efficient, operating line is indicated. Here again the straight line chart reflects a well understood absorption law, namely, that the most effective cooling is that applied to the upper section of a column.

We have previously indicated that a column's relative effectiveness is measured by the slope of its operating line. The reason for this, of course, resides in the factors composing A_E—which for small changes in column control, make A_E substantially proportional to the lean oil circulation rate. Under these circumstances, the steeper the operating line the smaller the value of A_E, and the smaller the quantity of lean oil required for a given key component recovery. Consequently, that column which exhibits the steepest slope for a given operating pressure is the most effective, and when several columns containing the same number of trays are concerned, the most efficient.

(Continued on Page 71)

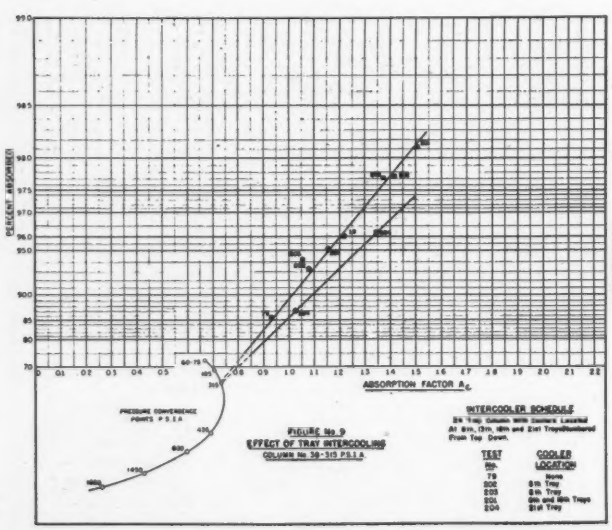


FIGURE No. 9
EFFECT OF TRAY INTERCOOLING
COLUMN No. 38-315 P.S.I.A.

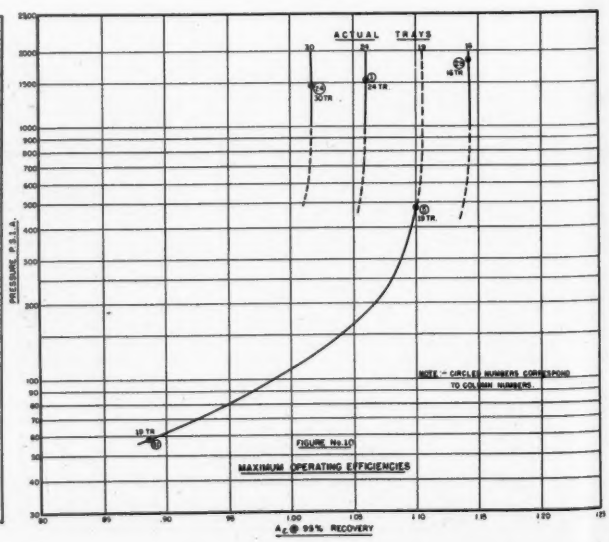


FIGURE No. 10
MAXIMUM OPERATING EFFICIENCIES

C.N.G.A. Annual Fall Meeting Breaks Records

California Natural Gasoline Association's 21st Annual Fall Meeting held at the Ambassador Hotel October 11th was attended by about 750 men from all parts of the State with at least twelve coming from Mid-continent areas or farther east.

Both morning and afternoon sessions featured papers by authors recognized as authorities on their subject, with the papers themselves dealing with problems of considerable timely interest.

A new feature inaugurated in connection with this meeting was a meeting of eastern visitors, most of whom were technical men, with the C.N.G.A. Technical Committee and others interested, the day before the convention. At this session current work of C.N.G.A. and Natural Gasoline Association of America and other technical groups was discussed and ideas exchanged which should prove of benefit in working out of problems of mutual interest. In view of the success of this meeting it is anticipated that the session may become a regular in connection with the annual meeting with the possibility that it may be made of longer duration.

M. W. Kibre, president of the Association, in addressing the group at the opening of the afternoon session on Friday, pointed out the aims and purposes of the Association and told of the large number of men engaged in committee work necessary to carry on the program of C.N.G.A. Kibre also called attention to the fact that the Association works closely with other technical groups and has recently been invited by A.S.T.M. to sit on its newly organized Committee H on Light Hydrocarbons. In closing, Mr. Kibre told of the success throughout the past year of monthly meeting programs both in the Los Angeles area and by the Taft Chapter.

The traditional banquet and show which has followed the daytime sessions beginning with the first Annual Meeting twenty-one years ago was held in the Embassy Room of the hotel. Guests at this event numbered well over 700 for an all time record for the Association. The variety entertainment following dinner furnished many good laughs to wind up the day as another success for C.N.G.A.

EASTERN VISITORS TO THE 1946 FALL MEETING OF CALIFORNIA NATURAL GASOLINE ASSOCIATION, AMBASSADOR HOTEL, LOS ANGELES, OCTOBER 11, 1946: Front row, left to right: H. W. Harts, Warren Petroleum Co.; E. M. Fanning, E. I. Du Pont de Nemours & Co.; E. O. Mattocks, Phillips Petroleum Co.; Leo Wilmeth, Shamrock Oil & Gas Corp.; H. B. Shelton, Sohio Petroleum Co.; Wm. F. Lowe, Natural Gasoline Assn. of America. Rear row, left to right: D. T. McDonald, Magnolia Petroleum Co.; C. R. Williams, Chicago Corp.; E. O. Bennett, consulting engineer; R. E. Miller, E. I. Du Pont de Nemours & Co.

SPEAKERS WHO PARTICIPATED IN THE PROGRAM OF THE 1946 ANNUAL FALL MEETING OF CALIFORNIA NATURAL GASOLINE ASSOCIATION, AMBASSADOR HOTEL, LOS ANGELES, OCTOBER 11, 1946: Front row, left to right: C. D. Gard, Union Oil Co. of Calif.; J. A. Richardson, Bechtel Bros. McCone Co.; B. H. Sage, Calif. Institute of Technology; E. G. Ragatz, consulting engineer; Hugh F. Colvin, consulting engineer. Rear row, left to right: R. C. Alden, Phillips Petroleum Co.; A. M. Whistler, C. F. Braun & Co.; Wm. N. Lacey, Calif. Institute of Technology.

SPEAKERS LUNCHEON, AMBASSADOR HOTEL, LOS ANGELES, OCTOBE 46,

Around outside of table beginning lower left corner: D. M. Wolfe, Standard Oil Co. of Calif.; E. O. Mattocks, Phillips Petroleum Co.; Ray E. Miller, E. I. Du Pont de Nemours & Co.; H. W. Harts, Warren Petroleum Corp.; E. O. Bennett, consulting engineer; H. B. Shelton, Sohio Pet. Co.; P. W. Mettling, Cooper-Bessemer Co.; J. A. Richardson, Bechtel Bros. McCone Co.; H. F. Colvin, consulting engineer; Wm. N. Lacey, Calif. Institute of Technology; R. C. Alden, Phillips Pet. Co.; R. D. Gibbs, Union Oil Co.; C. R. Williams, Chicago Corp.; G. L. Tyler, C.N.G.A.; M. W. Kibre, General Pet. Corp.; Wm. F. Lowe, N.G.A.A.; F. J. Colton, Tide Water Assoc. Oil Co.; Leo Wilmeth, Shamrock Oil & Gas Co.; E. G. Ragatz, Bechtel Bros. McCone Co.; R. E. Vivian, Univ. of So. Calif.; C. D. Gard, Union Oil Co.; B. H. Sage, Calif. Institute of Technology; C. L. Hutchings, Tide Water Assoc. Oil Co.; R. C. Enderly, Wilmington Gasoline Co.; H. L. Eggleston, General Pet. Corp.; A. H. Bell, Continental Oil Co.; H. M. Paulsen, The Norwalk Co.; G. F. Howells, Tide Water Assoc. Oil Co.; B. A. Ecker- son, C ARC Monro McFa Herro Rifen Co.; Corp.

OBE 46, FALL MEETING CALIFORNIA NATURAL GASOLINE ASSOCIATION

son, Calif. Research Corp.

AROUND INSIDE OF TABLE beginning left foreground: W. C. Monroe, California Oil World; L. E. Woodruff, The Texas Co.; D. E. McFaddin, Union Oil Co.; E. B. McCartney, The Fluor Corp., Ltd.; J. C. Herron, Shell Oil Co. Inc.; H. E. Moulton, C. C. M. O. Co.; W. L. Rifenberick, Industrial Engineers, Inc.; R. W. Heath, Signal Oil & Gas Co.; D. T. McDonald, Magnolia Pet. Co.; W. H. Kraft, Honolulu Oil Corp.; H. W. Parmelee, Del Valle Gasoline Co.; J. H. Rogers, The Cooper-Bessemer Co.; P. S. Magruder, General Pet. Corp.; G. C. McLaren, Standard Oil Co.; H. R. Linhoff, Richfield Oil Corp.; T. L. Taggart, Standard Oil Co.; R. S. Tulin, Shell Oil Co. Inc.; W. A. Kirk, Calif. Southern Oil Co.; M. L. Arnold, Richfield Oil Corp.; M. L. Fort, Pacific Lighting Corp.; W. C. Dayhuff, Calif. Research Corp.; E. P. Valby, Richfield Oil Corp.; D. B. Johns, Calif. Research Corp.; E. A. Brock, Southwest Welding & Mfg. Co.; C. B. Bason, Ingersoll-Rand Co.; E. M. Fanning, E. I. Du Pont de Nemours & Co.

American Association of Petroleum Geologists

Pacific Section 1946 Fall Meeting

The American Association of Petroleum Geologists, Pacific Section will hold its twenty-third Annual Fall meeting on Thursday and Friday, November 7 and 8 at the Ambassador Hotel in Los Angeles. At this time geologists and members of the oil industry will gather to hear talks on a wide variety of interesting subjects related to petroleum geology and the search for oil. In addition to West Coast geologists, several officers and members of the National organization of the A.A.P.G. will be in attendance at the meeting, among them being Earl B. Noble, Union Oil Company, National President of the American Association of Petroleum Geologists; Monroe Cheney, Coleman, Texas, Past President; J. P. D. Hull, Tulsa, Oklahoma, Business Manager of the Association's monthly Bulletin; and J. J. Jakosky, Los Angeles, National President of the Society of Exploration Geophysicists.

The two day meeting will also include concurrent meetings of two affiliated groups of the Association, the Pacific Coast District of the Society of Exploration Geophysicists and the Pacific Section of the Society of Economic Paleontologists and Mineralogists. These two societies will hold their meetings on Thursday morning, while the geologists' session will commence Thursday afternoon.

Twelve talks are on schedule for the geologists' sessions. At the opening gathering on Thursday afternoon a topic of considerable interest will be discussed when Graham B. Moody of Standard Oil Company speaks on "The Effect of World War II on California Oil Reserves."

Professor A. I. Levorsen of Stanford University will hold the attention of the geologists with his talk on "Time of Oil and Gas Accumulation," which will cover a perplexing problem in petroleum geology.

"Tidal Waves from the Recent Aleutian Earthquake" by Francis P. Sheppard, Scripps Institution of Oceanography, will be a description of the sudden movement on the ocean bottom occurring on April 1, 1946, which started a large train of sea waves causing considerable damage as far away as the north coasts of the Hawaiian Islands.

Dr. Siemon W. Muller, Professor of Geology at Stanford University will conclude Thursday's session with a talk on "Permafrost and Related Engineering Problems" in which he will describe the manner in which frozen ground in the northern hemisphere hinders the activities of man there.

On Thursday evening the Society of Economic Paleontologists and Mineralogists will convene at 6:30 at the Mona Lisa Cafe in Los Angeles for a dinner meeting at which time Dr. J. Wyatt Durham, California Institute of Technology, will speak on "The Cretaceous of Colombia."

Friday morning's session will be concerned with the problems of the origin, accumulation and migration of oil as they apply to certain oil localities in California, these talks being given by California geologists who have studied the problem in those areas.

A highlight of the meeting will occur at the Friday afternoon meeting when Wallace E. Pratt, Consulting Geologist and an American As-

J. R. Dorrance
The Texas Company
(Arranged the program for the Fall Meeting for the geologists, and who will preside at the opening session, Thursday afternoon.)

C. H. Dresbach
Western Gulf Oil Co.
(Chairman Program Committee for the Society of Exploration Geophysicists, who are holding a concurrent meeting with the geologists.)

G. R. Bell

Western Gulf Oil Co.

(Publicity Chairman for the Pacific Section)

sociation of Petroleum Geologists Distinguished Lecturer, speaks on the subject, "Petroleum on the Continental Shelves." This subject is a challenge to the ingenuity of the geologist and the engineer.

Following this talk, some of the newer oil discoveries of last year will be discussed by men connected with these discoveries, and the meeting will be brought to a close with D. F. Hewett of the United States Geological Survey speaking on "Stratigraphic and Structural Features of the Ivanpah Quadrangle, Southeastern California."

Included in the Geophysicists program on Thursday morning, November 7, will be a round-table of discussion on the much debated problem of "Multiple Reflections," led by T. P. Ellsworth of the Richfield Oil Corporation and some interesting comments on the "Bikini Atom Bomb Experiments" by R. B. Moran, Jr., U. S. Navy Research.

As a finishing touch to the Annual meeting, a dinner dance will be held in the Embassy Room of the Ambassador Hotel on Friday evening for all members and friends of the Association and its affiliated groups.

Following is the complete program for the two day session:

Thursday Morning - November 7

Economic Paleontologists and Mineralogists

9:30-11:30—Ambassador Theatre

9:30 (1)—"Notes on the Stratigraphy of the Santa Maria District" —Aden W. Hughes, Union Oil Company.

10:00 (2)—"The Ostracoda in Paleography"—W. L. Rothwell, Jr., Richfield Oil Corporation.

10:30 (3)—"The Glendora Volcanics"—John S. Shelton, Pomona College.

11:00 (4)—"Highlights of Washington and Oregon Biostratigraphy" —R. Stanley Beck, Consulting Paleontologist, Bakersfield.

Concurrent Session

Thursday Morning - November 7

Society of Exploration Geophysicists, Pacific Coast District

8:30-11:45—Gold Room, Ambassador Hotel.

9:20 (1)—"Multiple Reflections" —T. P. Ellsworth, Richfield Oil Corporation.

10:45 (2)—"Case History of the Wasco Field, California"—E. L. Erickson, Continental Oil Company.

11:00 (3)—"Correlation Record Grading"—Phil Gaby, Standard Oil Company of California.

11:30 (4)—"Bikini Atom Bomb Experiments"—R. B. Moran, Jr., Navy Research, Pasadena, Calif.

Thursday Noon

Luncheon Embassy Room, Ambassador Hotel.

1.—Introduction of National officers.

2.—Comments on A.A.P.G. Research Program by E. B. Noble, National A.A.P.G. President, Union Oil Company.

Thursday Afternoon

American Association of Petroleum Geologists, Pacific Section.

2:15 (1)—"Tidal Waves from the Recent Aleutian Earthquake" — Francis P. Sheppard, Scripps Institution of Oceanography, La Jolla, California.

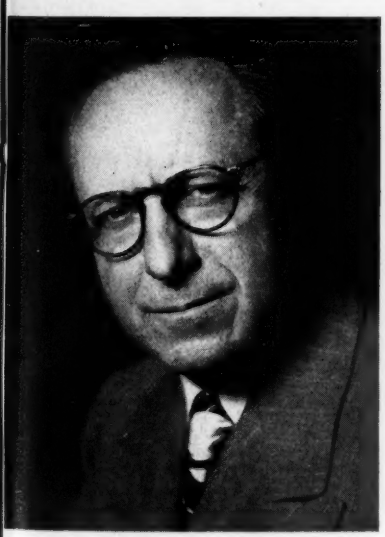
2:55 (2)—"Effects of World War II on California Oil Reserves"—Graham B. Moody, Standard Oil Company of California.

3:45 (3)—"Time of Oil and Gas Accumulation" — A. I. Levorsen, Stanford University.

4:15 (4)—"Permafrost and Related Engineering Problems"—Siemon W. Muller, Stanford University.

Thursday Evening

A meeting of the Society of Economic Paleontologists will be held at the Mona Lisa Cafe, 3343 Wilshire Blvd. Dr. J. Wyatt Durham, California Institute of Technology, will speak on "The Cretaceous of Colombia."



Wayne Loel
Burnoel Petroleum Co.
(Presiding over the Friday morning geological session.)

Frank B. Carter
General Petroleum Corp.
(Chairman of Arrangements Committee for the Fall Meeting)

E. R. Atwill
Union Oil Co.
(President of Pacific Section)

Friday Morning — 9:00-12:00

American Association of Petroleum Geologists, Pacific Section.

9:00 (5)—"Origin and Migration of Oil into Sespe Red Beds"—Thomas L. Bailey, Rothschild Oil Company.

9:50 (6)—"Evidence Supporting Lateral Migration of Oil, San Joaquin Valley, California"—Glenn C. Ferguson, Consulting Paleontologist, Bakersfield, California.

10:40 (7)—"Accumulation of Oil in Continental Sediments at the South Belridge Oil Field"—E. J. Coenen and H. D. Hobson, General Petroleum Corporation, Bakersfield, California.

11:30—Business Session.

Friday Afternoon—1:30-4:30

1:30 (8)—"Petroleum on the Continental Shelves"—Wallace E. Pratt, A.A.P.G. Distinguished Lecturer, New York City, N. Y.

2:30 (9)—"Geology of Basement Complex Edison Oil Field, Kern County"—J. H. Beach, Independent Exploration Co., and Harry Campbell, Jergins Oil Company.

2:45 (10)—"Santiago Pool, Kern County, California" — Glen W. Ledingham, Western Gulf Oil Co.

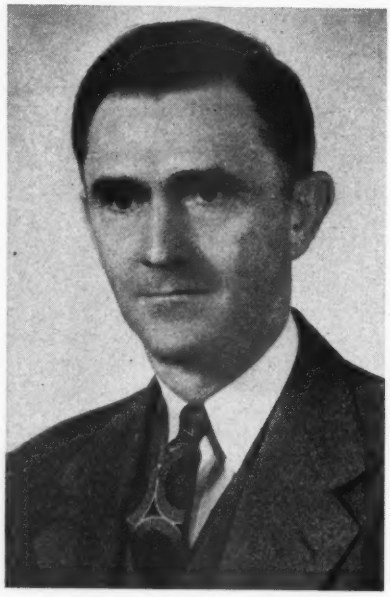
3:00 (11)—"Ramona Field, Los Angeles and Ventura Counties"—Loyal E. Nelson, Consulting Geologist, Los Angeles.

3:15 (12) — "Stratigraphic and Structural Features of the Ivanpah Quadrangle, Southeastern California"—D. F. Hewett, United States Geological Survey, Washington, D. C.

Friday Evening

Dinner Dance — Embassy Room, Ambassador Hotel.

A. S. Holston
Tide Water Associated Oil Co.
(Secretary-Treasurer of the Pacific Section)



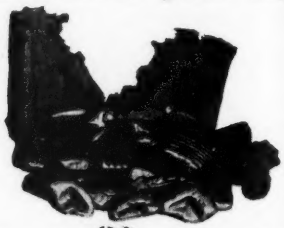
V. W. Vandiver
Seaboard Oil Corp.
(Vice-president of Pacific Section)

One of the most important wildcat tests in the state is Pacific Western Oil Corp.'s National Royalties No. 1 in the Miramonte area of Kern County. It was spudded the last day of 1945 and under the proficient guidance of the contractor, Loffland Bros. Co., has reached at this writing approximately 15,675 ft. without a fishing job of any description. It has probably set a new record for a contract job in Calif.

Plan Deep Try At McKittrick

Northeast of the old McKittrick shallow field, Wilshire Oil Co. is ready to start work on its McKittrick No. 2, a scheduled deep test in Sec. 12-30s-21e. In the Jacalitos area, the company is drilling No. 81-28E in Sec. 28-21s-15e at 3500 ft. Temblor oil sand was cored at 3313-3360 ft. and 3368-3407 ft. Top Temblor is placed at 3313 ft.

HORSING AROUND
won't get this sort of junk out of your well!



(Below) An assortment of Metal Junk

(Above) Rubber Sleeve, Slips, and Pieces of Body of Bridging Plug

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TAFT
200 Center St. — Phone 870

The Economic Outlook for California L. P. G.

By

Clare Gard, Union Oil Company of California
and
Hugh F. Colvin, Consulting Engineer

OCTOBER MEETING

There are many factors which naturally present themselves in any discussion of L.P.G.—trade term for liquefied petroleum gas and specifically propane, butane and their mixtures. Because of the many possible variations in its production and refinery and marketing utilization, it has often been looked on as one of the problem children of the petroleum industry.

In review, propane and butane fractions are contained in field wet gas, condensate, and, to a small extent, in most light crude oils. They are also produced in large quantities in refinery cracking and reforming operations. They may be recovered partially or completely; as propane, butane, or mixtures of the two; or they may even be segregated into the various possible isomers with high degrees of purity. They may be left in so-called dry gas to be sold as natural gas, used for refinery fuel, used as blending agents in gasolines, sold for domestic heating purposes, for internal combustion engine fuel, for the manufacture of chemicals, or they may be alkylated or polymerized to yield gasoline-range components.

The economic permutations and combinations involved in such a complex pattern are extremly numerous. The following questions are typical:

What products should field absorption plants be designed to recover?

What recovery factors, what purity factors should be attained?

Is it preferable to sell propane, butane, or mixtures of the two as commercial L.P.G. at field plants, or to transport them to refineries for gasoline blending, alkylation, or polymerization?

Should a high vapor pressure natural gasoline be produced to serve as a transportation medium for L.P.G. fractions to the refinery, or should L.P.G. be moved separately?

How can the greatest return be secured from L.P.G. fractions produced in refinery operations?

Many other questions besides these could be brought to mind and much space devoted to their discussion. This paper, however, will be restricted to the following fundamentals:

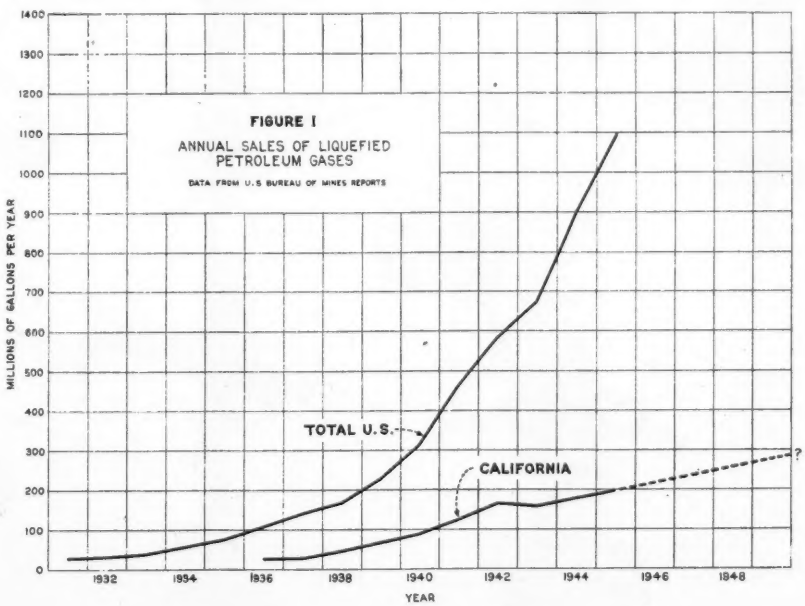
1. The trend of growth of L.P.G. demand.
2. The trend of L.P.G. supply.
3. The future economic outlook.

Demand:

The rapid and continuous growth in L.P.G. sales demand since the early 1930's is shown graphically in Figure 1. The amazing increase has been commented on many times before, but as yet, little evidence is available to indicate a tapering off of the upward trend. It is of particular interest, however, to note that California has consistently lagged behind the total United States in rate of increase, and, if anything, this difference is being accentuated. However, even with a rather conservative extrapolation of the California trend as shown on the chart, sales of L.P.G. may be expected to increase about 50% over present levels by the end of 1950.

Figure 2 shows a ten-year development pattern for L.P.G. sales by type of consumption. Throughout the period, domestic heating and internal combustion engines provided the greatest outlet for L.P.G., exclusive, of course, of refinery consumption.

With regard to the future, three of the classifications warrant special comment. It is believed that considerable opportunity exists for continued expansion of domestic heating sales into marketing areas in the Pacific Northwest and the more remote sections of Northern California where L.P.G. offers a marked advantage in handling convenience over coal and wood, and where the per-therm cost differential may be lessened by increases in the costs of these competitive fuels. Increased heating demand will also be occa-



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sioned by the steady growth in population of the Pacific States.

It may be interesting at this time to compare the relative values of the various competitive fuels. Table IV presents these relative values based on a 3.5c/Gal. value for commercial propane and 4.0c/Gal. for propane-butane mixtures. These values for propane and butane were used for discussion purposes only and other relative values may be obtained by comparison, using different basic values for propane and butane. These relative values indicate that, from a therm basis, the competitive fuel can be used to an economic advantage when its price is equal to or less than that indicated in the table.

The use of L.P.G. in chemical manufacture may also be expected to increase, particularly from the standpoint of refinery propylenes and butylenes.

The third category in which substantial growth is still in sight is that of internal combustion engines, both stationary and automotive.

For comparative purposes, Figure 3 shows the distribution of L.P.G. sales in 1944 by commodity and by use; in these charts the areas are proportional to volume of sales. Unfortunately, a complete breakdown is not yet available for 1945 nor are comparable figures available for more than a few prior years. It seems to be the consensus of the industry that the position of commercial propane will become increasingly more important because of the greater relative economic value of butane fractions for other uses. It is certain that this trend was augmented during the war by the heavy demand for iso-butane for alkylation in the 100 octane gasoline program. For the next few years, however, the butane-propane mixtures known to the trade as commercial butane will probably continue to dominate the sales field. Further growth in sales of butane as such is not expected.

Supply:

Will the supply of L.P.G. be able to keep up with the indicated sales demand? The answer is undoubtedly yes subject to certain economic qualifications which will be discussed later. Figure 4 illustrates

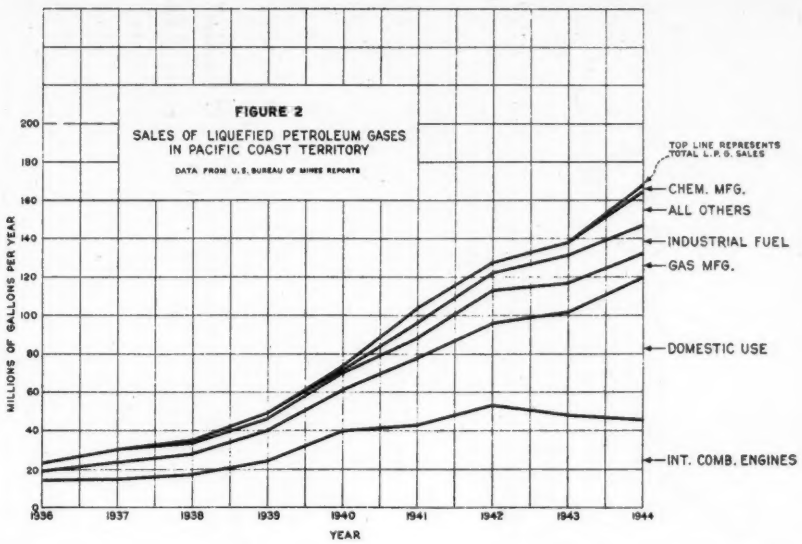


TABLE I

STATUS OF CALIFORNIA LIQUEFIED PETROLEUM GAS PRODUCTION FROM FIELD PLANTS

	Los Angeles Basin	San Joaquin Valley	Coastal Area	Total
1. Number of Plants Producing*				
Commercial Propane	10	12	3	25
Commercial Butane	3	9	4	16
2. Actual Production First Half of 1946—M Gallons Per Day†				
Propane	22	87	22	131
Butane	2	168	27	197
Commercial	14	146	19	179
Total	38	401	68	507
3. Potential Production—M Gallons Per Day‡				
Propane	48	274	38	360
Butane	12	254	32	298
Commercial Butane	5	38	28	71
Total	65	566	98	729
4. Stated Capacity—M Gallons Per Day#				
Total L. P. G.	....	....	....	358

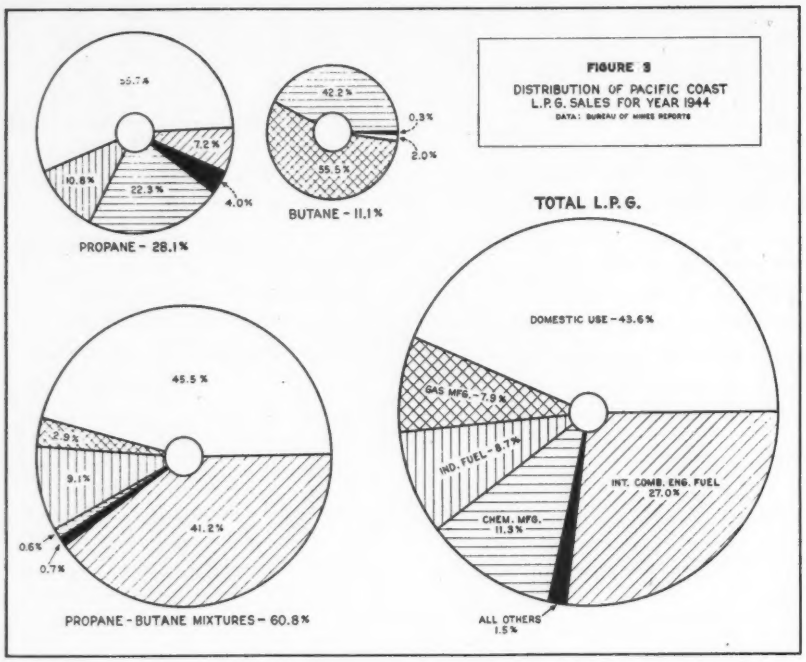
*—Based on individual survey—checked by C.N.G.A. data.
†—C.N.G.A. data.
‡—Individual plant survey based on existing facilities.
#—Data from "Oil and Gas Journal," April 20, 1946, only 16 plants reported as producing L.P.G.

TABLE II

LIQUEFIED PETROLEUM GAS STORAGE AND LOADING FACILITIES AT CALIFORNIA FIELD PLANTS*

	Los Angeles Basin	San Joaquin Valley	Coastal Area	Total
Storage Facilities—M Gallons†				
Propane	53	385	157	595
Butane	...	943	120	1,063
Commercial Butane	75	420	96	591
Total	128	1,748	373	2,249
Number of Plants with Loading Facilities				
Truck and Trailer	9	14	5	28
Tank Car	1	6‡	1	8
Pipe Line	1	3	.....	4

*—Based on individual plant survey.
†—Information on storage facilities at one Los Angeles Basin Plant and one San Joaquin Valley Plant not available.
‡—Rail facilities now being installed at two additional San Joaquin Valley Plants.



graphically the relationship between field plant production of L.P.G. and sales demand. The difference between these two may be represented as net effective refinery production. This is by no means the whole story, however, and Figure 5 (on a different scale than Figure 4) shows how small the net refinery production is in relation to the gross production from all cracking, reforming, stabilizing, and other operations. The balancing figure representing net refinery consumption is influenced partly by the availability of physical facilities but primarily by the economic relationships between L.P.G. sales netbacks and the equivalent value of L.P.G. fractions for gasoline blending, polymerization, and other refinery uses. The important thing to keep in mind is that the potential L.P.G. available from maximum refinery operations plus that available from maximum field operations far exceeds the foreseeable sales demand for the next few years. In this respect, California is quite in line with the rest of the country.[1] It must be admitted that some capital expenditures would be necessary for additional fractionating and especially storage and handling facilities before this maximum potential L.P.G. could move into trade channels. But this also will be governed by economics; and once butane and propane fractions are produced their recovery and utilization are largely determined by practical dollar-and-cents economic analyses.

With regard to refinery production, it is interesting to note the high peak in 1945 which was associated with a record volume of crude and cracking plant operations, and in particular with new catalytic cracking operations which were one of the outstanding features of the wartime refinery expansion program. These catalytic cracking operations are continuing at a high rate and will undoubtedly be maintained permanently for reasons of gasoline quality. Aside from their effect on increasing refinery L.P.G. fractions, these catalytic operations are noteworthy for the very large proportion of iso-butane and butylenes in the effluent C_4 fraction, which has an important bearing on alkylation economics.

It is believed that the reported cracking production and refinery consumption of L.P.G. fractions are low because the processing operations of some refineries are so closely integrated that it is not possible to measure certain L.P.G. streams in the intermediate stages and only the net figure is reported.

An interesting hypothetical picture of the effect of cracking on refinery L.P.G. production is shown in Table III, where comparisons are made between straight-run distillation of crude, distillation fol-

TABLE III

EFFECT OF REFINERY CRACKING OPERATIONS ON L.P.G. PRODUCTION
Basis 10,000 B/D of 30° L. A. Basin Crude

	I Straight-Run Distillation	II (I) Followed by Thermal Cracking of Gas Oil and Residuum	III (I) Followed by Recycle Catalytic Cracking of Gas Oil and Thermal Cracking of Residuum
Product Yield—B/D			
Propane	8	149	170
Propylene	.....	327	186
Iso-Butane	20	101	174
Normal Butane	60	222	225
Butylene	.....	162	303
Total $C_3 + C_4$	88	961	1,058
C_4-Free Gasoline	3,160	6,243	6,355
Gas Oil	3,360	.....	.....
Residuum	3,390	3,109	2,642
C_2 and Lighter (FOE)	2	304	258
Loss (Gain)	.....	(617)	(313)
Total	10,000	10,000	10,000
Net Products—B/D			
C_3	8	476	356
C_4*	(235)	(132)	149
Gasoline (10# R.V.P.)	3,475	6,860	6,908
Distillate Fuel	3,360	.....	.....
Residual Fuel	3,390	3,109	2,642
Fuel Gas (FOE)	2	304	258
Loss (Gain)	.....	(617)	(313)
Total	10,000	10,000	10,000

*—Deficiency of butane in Cases I and II is net after providing for blending motor gasoline to 10 lbs. R.V.P.

owed by thermal cracking of gas il and residuum, and distillation ollowed by recycle catalytic crackng of gas oil and thermal cracking f residuum. For better contrast, he primary products have been adusted for a 10 lb. R.V.P. gasoline lend, using butane as a blending gent. No provision is made for lkylation or polymerization which ould be justified in most refineries nd which would convert part or all f the surplus L.P.G. to gasoline.

With regard to field plant production, it seems probable that if economic conditions warrant, additional L.P.G. can be obtained through installation of new facilities or improvement of existing ones. It is difficult to get a reliable survey of potential production from existing facilities but Tables I and II present some interesting data which were assembled recently. Some confusion apparently exists as to what constitutes "potential" production, causing unexplainable differences between actual and potential production by commodities, but it is believed the comparisons for total L.P.G. are significant.

The indicated potential production with existing facilities in field plants is about 230,000 gallons per day higher than the actual for the first half of 1946 in the case of propane, whereas the actual production of butane plus commercial butane was about equal to the indicated potential. By converting commercial butane to butane and propane on the rough assumption of a 50-50 proportion, the following comparisons are obtained for total California field L.P.G. in gallons per day: (Oberfeld and Thomas, Oil & Gas Jrnl. June 8, 1946 PP 60-1.

	Actual—First Half of 1946	Potential
Propane	220,000	395,000
Butane	287,000	334,000
Total	507,000	729,000

This may be taken as rough evidence that 86% of the potential butane and only 55% of the potential propane are now being recovered. From Table II, it is seen that present field plant storage facilities are sufficient to handle only 4½ days average production. This points up another problem of handling L.P.G., namely, the difficulty and expense of providing suitable storage to even out day-to-day surges of production or sales demand in order to attain maximum annual recovery.

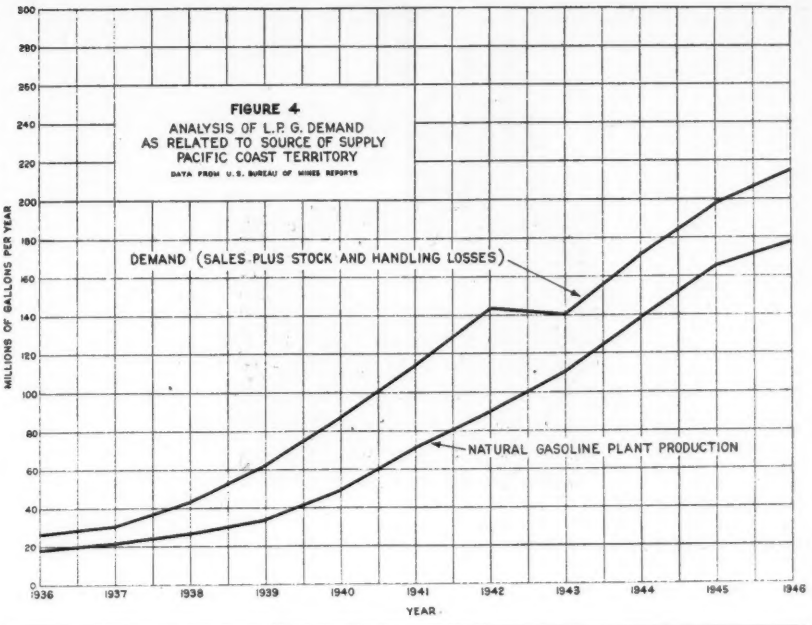


TABLE IV

COMPARISON OF THE RELATIVE VALUES OF THE MORE COMMON FUELS* BASED ON PROPANE AND COMMERCIAL BUTANE

Fuel	Quantity	Relative Value Based on Propane at 3.5¢/Gal.	Relative Value Based on Commercial Butane at 4¢/Gal.
Fuel Oil (Gravity 9-12)	1 Bbl.	$ 2.43	$ 2.62
Natural Gas (1150 BTU/Cu. Ft.)	1,000 Cu. Ft.	$ .44	$ .47
Coal (Anthracite-Bituminous)	1 Ton	$10.54	$11.34
Stove Oil (Gravity .8314)	1 Gal.	5.28¢	5.68¢
Electricity	1 Kw. Hr.	.13¢	.14¢

*—The theoretical heating values were used for the various fuels and relative values shown do not take into consideration the efficiency of conversion to useful energy.

TABLE V

COMPARISON OF YEARLY CRUDE OIL AND NATURAL GAS PRODUCTION FOR CALIFORNIA

Year	Crude Oil Production (Bbls./Day)	Natural Gas Production (Mcf/Day)	Gas Oil Ratio
1935	570,000	835,253	1.47
1936	585,000	961,115	1.64
1937	655,000	918,735	1.40
1938	685,000	960,731	1.40
1939	615,000	944,964	1.54
1940	610,000	979,442	1.60
1941	630,000	985,736	1.56
1942	685,000	891,911	1.30
1943	780,000	959,910	1.23
1944	860,000	1,139,267	1.32
1945	890,000	1,245,542	1.40
1946 (Est.)	855,000	1,235,738	1.44

Economics:

Much pertinent information on L.P.G. economics is of course hidden behind the secrecy of individual company operation. The following comments are to be viewed as hav-

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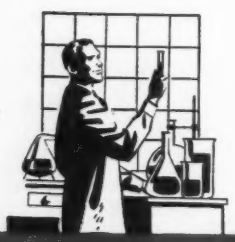

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g only general validity and must e modified by individual circumtances of transportation, refinery osts, sales netbacks, etc.

One of the most important conderations to the individual L.P.G. roducer is the disposition of his roduct which will bring the greatst value. At the present time, the llowing sequence from highest to west appears to prevail in Calirnia:

1. Blending agent in motor gasoine to provide front-end volatility p to limits of vapor pressure specications. (Butane fractions only)
2. Refinery processing of refinery .P.G. by catalytic polymerization, lkylation, or thermal polymerizaion to yield gasoline range compoents. (Primarily olefins and isoutane)
3. Sales as commercial L.P.G.
4. Refinery processing of field .P.G. (Butane only)
5. Diversion to refinery fuel or atural gas.

Considerable question exists as to he economic value of alkylation and olymerization. Of course, the forer is required for the production f high-octane aviation gasoline, but is felt that both alkylation and atalytic polymerization can also be stified in most cases for motor asoline production when operating n refinery L.P.G. fractions up to he limit of iso-butane or olefin availbility. For field L.P.G., with the xception of some iso-butane treams, this is probably not the ase at the present time because of he effect of transportation costs, lthough it was necessary during he war. Thermal polymerization ppears to be uneconomical in most ases even for refinery L.P.G. These onclusions on refinery economics re in substantial agreement w' hose presented in detail by Parker[2] nd Perkins[3] at last year's C.N.G.A all Meeting.

Construction of new plants to conert field L.P.G. into gasoline fracions would certainly be regarded as hazardous economic adventure at he present time. However, looking head over a five or ten-year period, seems probable that because of ncreased gasoline demand, declinng crude supply, and increased findng, producing, and refining costs,

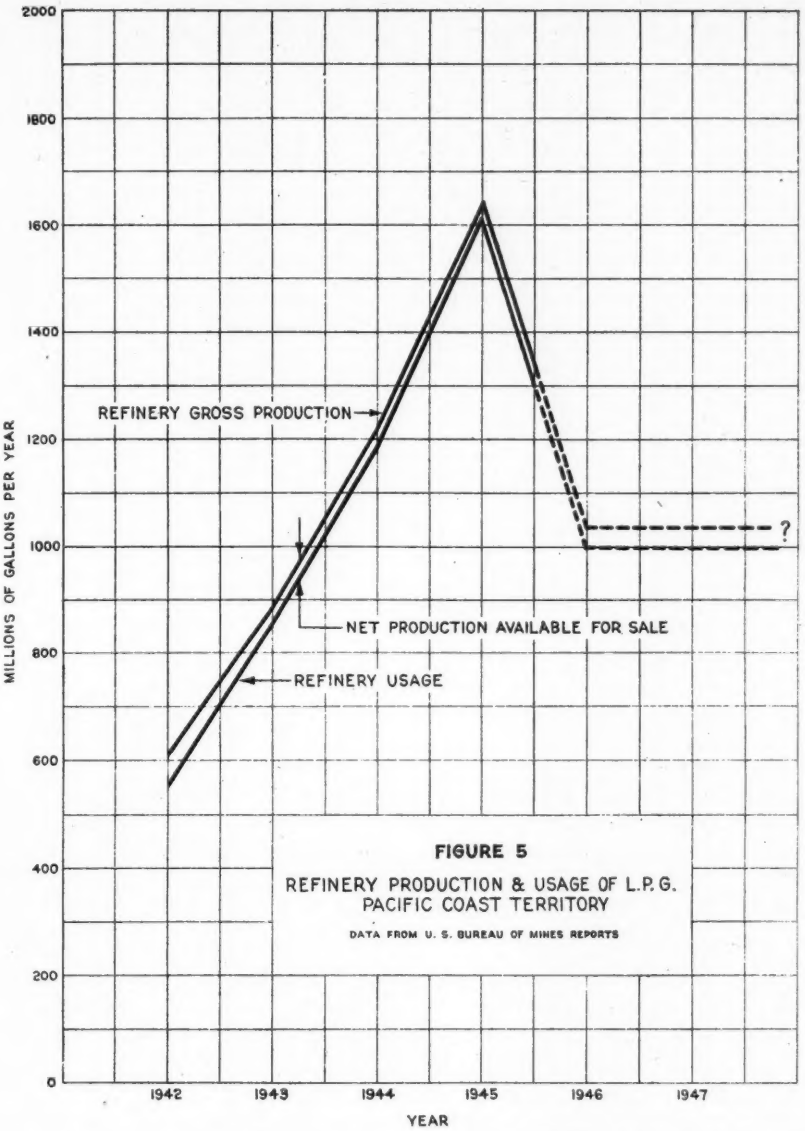


FIGURE 5

REFINERY PRODUCTION & USAGE OF L.P.G. PACIFIC COAST TERRITORY

DATA FROM U. S. BUREAU OF MINES REPORTS

the price of gasoline will move upward. As this takes place, the equivalent value of propane and butane fractions for conversion to gasoline will likewise rise, and it is to be expected that the market price for commercial L.P.G. will be equalized with this refinery conversion value. In this connection, Figure 6 is of interest as a projection of the supply and demand for California crude through the year 1950. If, as is indicated, the supply of California crude falls below the demand in that period, the price levels for all petroleum products and byproducts will undoubtedly be stiffened, and L.P.G. will be one of the beneficiaries.

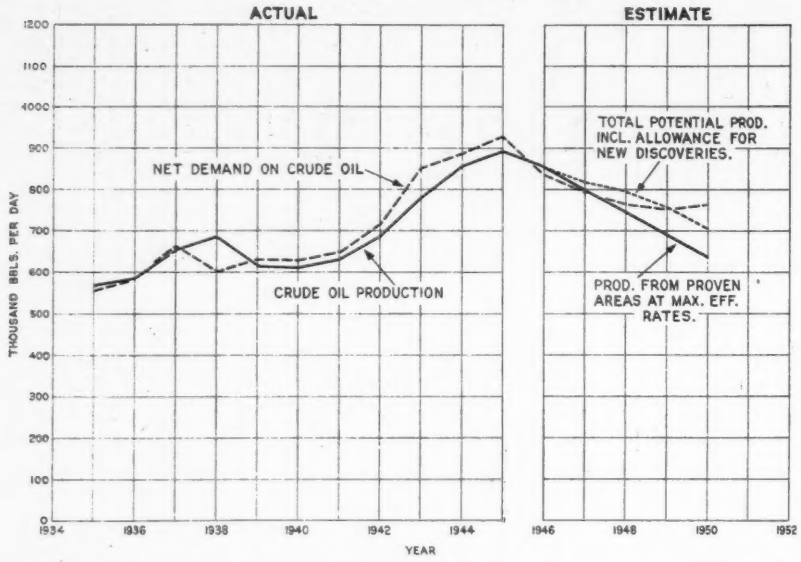
Table V presents production data of oil and gas for California fields for the period 1935 to 1946 inclusive. This table was prepared in the hope that it might present some relationship which would be useful in forecasting the probable L.P.G. future. Generally speaking, the ratio of gas to crude production has not varied greatly over the years and it appears reasonable to assume that crude oil production can be used as an index to anticipated L.P.G. production potentials.

One economic question which arises naturally in consideration of strengthening prices is that of withholding L.P.G. from low-value uses today in order to conserve it for higher-value disposition in the future. With the current installed steel storage cost of 20c to 25c per gallon

FIGURE 6

CALIFORNIA CRUDE OIL SUPPLY AND DEMAND PICTURE 1935 - 1950

DATA: U.S. BUREAU OF MINES REPORTS AND CALIF. CONSERVATION COMM. REPORTS



for propane-butane mixtures and 35c to 40c per gallon for propane, any sizable storage plant will cost a substantial sum. Manifestly, the storage of large quantities of L.P.G. above ground is questionable. There remains the possibility of utilizing underground reservoirs through injection of L.P.G. into subsurface formations. Little is known about the physical limitations of this and even less about the economic factors involved, but the problem may be worth some consideration.

One Mid-Continent producing company has reported some rather inconclusive data on underground storage which may be summarized briefly as follows:

Using semi-exhausted oil reservoir strata in some cases and, in other cases, productive natural gas strata which have not been produced to any degree at all, several millions of gallons were introduced, chiefly of commercial butane with smaller amounts of propane. Good results were obtained in at least two instances where the surplus materials were introduced into the well bore as liquids and which, at least to a considerable degree, remained in the reservoir as liquids, but little success was had in recovery of the liquids from the ground. In attempting to pump such liquids from the ground by various pumping means, the volatility was found such that at existing pressures, gasification would occur, resulting in abandonment of liquid pumping. Where reservoirs were under depleted pressures, the liquid gasified on introduction, but no particular difficulty was experienced from freezing. However, in one trial by another company, the hydrocarbons remained liquid in the ground but attempt at rapid recovery caused gasification and a tight freezing of the entire well structure necessitated prolonged discontinuance.

In one reservoir with an intermittent throughput of something like 10 million gallons, 90 to 95% of the first injected materials were recovered in the form of vapors which were handled through the regular gas gathering and processing facilities, appearing as so much excess L.P.G. Complete recovery has not been since attempted. With fixed plant extraction facilities, any additional throughput of high content propane or butane gas may overload the existing equipment to the extent that substantial increased production of propane and butane may not be fully realized. The production of such gases from storage zones to meet peak demand must be properly correlated with adequate extraction facility to give satisfactory results.

In connection with a high pressure gas reservoir, it was found when opening the well after liquid injection, that a 99% pure propane could be recovered in vapor form which, however, soon became contaminated with methane and other natural gas diluents long before recovery of any reasonable percentage of the injected liquids. Here again the presence of other hydrocarbon diluents may affect the overall recovery of the propane and butane and proper study should be made of all factors affecting the program.

It is the tentative opinion from these experiments that where a structure small in areal extent can be found and preferably one which has been depleted of natural gas or oil at relatively shallow depths, it should be possible to introduce light hydrocarbon liquids and to recover them in large degree in liquid and gaseous form. To date, no such structure has been utilized.

The authors wish to thank George P. Bunn, of the Phillips Petroleum Company, for his comments on underground storage of L.P.G. and W. L. Cowan, of the Union Oil Company of California, for his data on future L.P.G. potentials.

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[2]F. D. Parker, Proceedings 20th Annual Fall Meeting C.N.G.A. PP. 33-41.
[3]M. M. Perkins, Proceedings 20th Annual Fall Meeting C.N.G.A. PP. 27-32.

The Vaporsphere

The Chicago Bridge & Iron Company, Chicago, Illinois, announces the publication of a new 20-page booklet, "The Vaporsphere", It describes the method of reducing evaporation losses from flat-bottom tanks storing volatile liquids by installing a vapor-saving system with facilities for the temporary storage of vapor.

The method for determining the correct size of the Vaporsphere which is used for the temporary storage of the vapor, is discussed together with the method of designing the vapor lines which connect the flat-bottom tanks to the Vaporsphere. The vapor pressure, expansion of air-vapor mixture and the flow of vapor in the lines can be read directly from charts included in the booklet.

With Drilling Contractors

A record number of oil men were in attendance at the sixth annual meeting of the American Association of Oilwell Drilling Contractors at San Antonio, Tex. Registration was the largest in the history of the association and emphatic proof of the growing interest of members of the oil industry in the comprehensive work program of the organization.

E. C. Brown, Brown Drilling Co. of Long Beach, was elected vice president for California for the ensuing year.

Pacific Coast regional directors elected included F. L. Shepherd, Bakersfield; Karl L. Kellogg, K. L. Kellogg & Sons, and D. H. Graham, Dunlap & Graham, Long Beach; and A. S. Hayes, Hayes & Sprague, and Ralph W. Marshall, Drilling & Exploration Co., Los Angeles.

Among technical papers presented at the meeting was one on "California Drilling Practices" by F. N. Kellogg of the Kellogg contract organization at Long Beach.

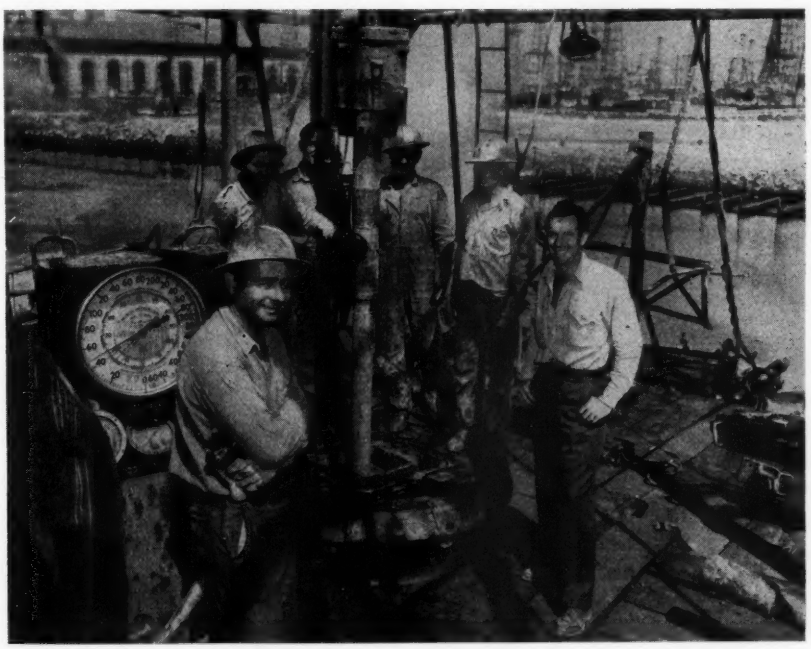
Many California drilling contractors in attendance at the San Antonio meeting toured important oil centers in Texas and Oklahoma before returning home. D. H. Graham of Dunlap & Graham, Long Beach, renewed old acquaintances in Tulsa and was a spectator at an exciting football game at Norman, Okla., where the University of Oklahoma holds forth.

Dunlap & Graham, incidentally, have recently completed two contract jobs for Long Beach Oil Development, and are drilling a third. Other of their present contracts include a well for Hancock Oil Co. in the Craig lease in the Harbor area, Pacific Lighting Corp., Miller No. 3 at Goleta; and Standard Oil Co.'s Surf No. 2-3 at Huntington Beach, and No. 343-4-G at Elk Hills.

K. L. Kellogg & Sons have taken on three more contracts. They are for Union Oil Co.'s Chapman No. 50, No. 51 and No. 52 in the Richfield area. Recent Kellogg completions include a producing well for the B. F. Porter Estate in the Aliso Canyon field.

The distinction of drilling on contract Amerada Petroleum Corp.'s first well in the Los Angeles Basin went to Hoyt Drilling Co. Amerada has made gas production history in Northern California and finally made its long expected debut in Southern California on the Anaheim Sugar property at Huntington Beach. Texas Co.'s evident new discovery of a wet gas field near old McKittrick was drilled by T. P. Pike Drilling Co. Severns Drilling Co. contractor for British-American Oil Prod. Co. on the Alondra Park No. 1 at Gardena, is seeking to duplicate their success in drilling the discovery well some months ago on the Bodger property.

Gene Reid Drilling Co., who so far this year has drilled a dozen important wildcat wells in California areas, may drill another well for Glenn Dial in the Pyramid Hills of Kings County. Tehama Exporation Co.'s test near Red Bluff in Tehama County is a contract job with Yarberry & Roberts Drilling Co. Standard's Newson Comm. No. 1 on wildcat ground near the Santa Fe Springs field is being drilled by H. S. Tenny. J. E. Pettijohn is in charge of operations.



Well No. 137 of the Long Beach Oil Development Co. is being drilled by Dunlap & Graham of Long Beach. Part of the crew is shown above left to right: "Chief" Robertson, driller; Bob Weber, cathead; Ray Patterson, lead tong; Bob Henderson, pipe racker; Mark Wilburn, derrickman and J. E. Deevers, tool pucher. The drill, when photo was taken, was at 3,020 ft. with completion expected at 6250 ft. flowing from the 237 zone underlying Terminal Island. Photo by Stiefler.

California Oil World's Monthly Summary

DEVELOPMENT—PRODUCTION—SUPPLY & DEMAND
PACIFIC COAST TERRITORY

TABLE I—CALIFORNIA DEVELOPMENT—PRODUCTION

	AUGUST, 1946 DEVELOPMENT				PRODUCTION	
	Active Drilling Wells	Oil Wells Completed	Initial Production B/D	Oil Wells Completed First 8 Months	Daily Average August 1946	Daily Average August 1945
SAN JOAQUIN VALLEY						
Ant Hill	2	.....	.....	8	1,423	59
Antelope Hills	.....	.....	.....	.....	1,529	1,76
Antelope Plains	.....	.....	.....	.....	.....	4
Arvin	.....	.....	.....	.....	26	5
Bellevue	.....	.....	.....	.....	332	59
Belridge—North	.....	.....	.....	.....	5,081	6,23
Belridge—South	5	1	19	67	10,652	13,15
Blackwell's Corner	.....	.....	.....	3	224	17
Brundage	.....	.....	.....	.....	.....	.....
Buena Vista Hills	1	3	1,213	17	38,977	49,21
Burrel	.....	.....	.....	.....	10	2
Canal	.....	.....	.....	.....	1,618	3,57
Canfield-Gosford	.....	.....	.....	.....	91	22
Canfield Ranch	.....	.....	.....	.....	33	3
Coalinga—East	.....	.....	.....	10	16,998	22,31
Coalinga—Nose	.....	1	620	2	56,643	57,15
Coalinga—West	.....	.....	.....	2	6,912	7,73
Coles Levee—North	3	1	154	6	15,731	15,77
Coles Levee—South	.....	.....	.....	1	782	2,92
Cymric	9	8	975	61	9,752	.....
Edison	1	1	7	67	14,051	5,79
Elk Hills	5	1	197	13	7,972	45,36
Fruitvale	.....	.....	.....	.....	7,404	8,49
Greeley	.....	.....	.....	4	10,681	16,13
Helm	2	.....	.....	21	4,062	3,52
Jacalitos	1	.....	.....	8	4,512	3,96
Kern Front	2	1	33	20	12,369	12,51
Kern River	3	3	38	13	9,868	9,96
Kettleman North Dome	2	1	1,372	16	36,753	40,44
Lanare	.....	1	127	15	2,621	5
Lost Hills	2	2	62	14	3,499	3,2
McClung	.....	.....	.....	.....	21	.....
McKittrick	1	.....	.....	4	4,496	5,7
Midway-Sunset	1	1	36	17	35,993	39,3
Mountain View	6	1	1,220	7	3,781	2,7
Mount Poso	.....	.....	.....	13	15,671	18,0
Paloma	10	2	1,305	15	6,275	2,7
Pleasant Valley	.....	1	408	2	3,411	3,7
Pyramid Hills	.....	1	.....	2	308	3
Race Track	1	.....	192	7	1,700	9
Raisin City	.....	.....	.....	5	2,661	3,2
Rio Bravo	.....	.....	.....	.....	12,997	16,8
Riverdale	.....	1	191	7	4,544	4,1
Rosedale Ranch	.....	.....	.....	.....	133	1
Round Mountain	2	2	162	5	9,064	9,6
Salt Creek	1	2	676	6	1,302	.....
Santiago	2	1	1,203	19	5,798	5
Sheep Springs	.....	.....	.....	3	450	6
Strand—East	.....	.....	.....	.....	606	6
Strand—West	.....	.....	.....	.....	2,103	1,4
Tejon	4	5	521	26	1,632	4
Ten Section	1	.....	.....	.....	9,090	12,1
Union Avenue	.....	.....	.....	.....	411	1
Wasco	.....	.....	.....	.....	702	1,1
Wheeler Ridge	.....	.....	.....	.....	233	2
Miscellaneous	.....	.....	.....	3	90	
TOTAL SAN JOAQUIN VALLEY	67	41	10,731	509	404,078	456,8
COASTAL AREA						
Aliso Canyon	2	2	1,349	6	3,154	3,2
Bradley Canyon	.....	.....	.....	.....	.....	.....
Capitan	.....	.....	.....	6	3,521	2,6
Del Valle	1	.....	.....	1	1,687	2,5
Elwood	1	1	334	6	7,155	5,9
Gato Ridge	.....	1	441	4	3,738	4,4
Hasley Canyon	.....	.....	.....	.....	.....	.....
Newhall-Potrero	3	.....	.....	6	5,937	5,7
Oak Canyon	.....	.....	.....	1	1,663	2,2
Oxnard	.....	.....	.....	.....	973	1,0
Padre Canyon	1	.....	.....	2	2,423	2,0
Ramona	6	3	492	17	1,383	2
Rincon	1	.....	.....	.....	4,254	4,4
San Martinez	.....	.....	.....	1	3,350	3,6

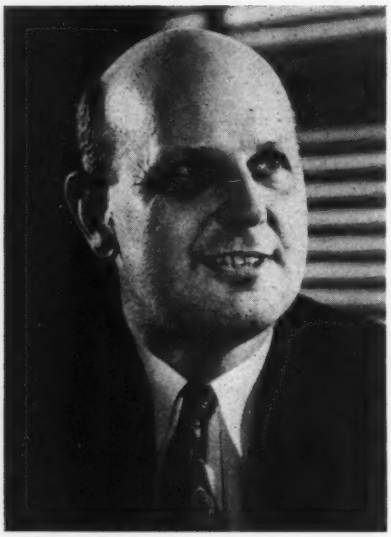
	AUGUST, 1946 DEVELOPMENT				PRODUCTION	
	Active Drilling Wells	Oil Wells Completed	Initial Production B/D	Oil Wells Completed First 8 Months	Daily Average August 1946	Daily Average August 1945
MONTHLY SUMMARY—Continued						
San Miguelito	3	.....	.....	5	5,114	5,251
Santa Barbara	.....	.....	.....	.....	80	142
Santa Maria	5	3	768	14	13,029	14,467
Santa Maria Valley	4	4	525	33	32,463	38,872
Summerland	.....	.....	.....	.....	12	.....
Ventura Avenue	8	5	2,048	31	46,985	52,315
Ventura-Newhall	6	4	327	15	7,053	6,099
Watsonville	.....	.....	.....	.....	20	25
Zaca Creek	.....	.....	.....	.....	328	271
Miscellaneous	.....	.....	.....	.....	.....	.....
TOTAL COASTAL DISTRICT	41	23	6,284	148	144,372	155,886
LOS ANGELES BASIN						
Brea-Olinda	2	.....	.....	3	10,755	11,512
Buena Park	.....	.....	.....	2	68	99
Coyote—East	2	1	148	5	4,609	4,928
Coyote—West	1	.....	.....	6	14,999	15,564
Dominguez	1	2	250	8	15,594	18,591
East Los Angeles	2	2	813	4	624	.....
El Segundo	.....	.....	.....	1	646	813
Gardena—West	.....	1	1,165	1	179	.....
Huntington Beach	5	2	637	32	47,067	47,686
Inglewood	.....	.....	.....	.....	12,561	15,032
La Mirada	1	.....	.....	1	40	.....
Lawndale	.....	.....	.....	.....	19	29
Leffingwell	.....	.....	.....	1	2	.....
Long Beach	.....	.....	.....	1	24,607	26,440
Los Angeles-Salt Lake	.....	.....	.....	.....	401	521
Montebello	.....	.....	.....	2	8,447	9,715
Newport-Costa Mesa	2	8	1,193	44	5,862	1,290
Playa Del Rey	.....	.....	.....	.....	2,352	2,537
Potrero	.....	.....	.....	1	860	1,066
Richfield	.....	1	94	6	7,446	7,653
Rosecrans	.....	1	54	3	4,980	5,727
Sansinena	.....	.....	.....	.....	74	44
Santa Fe Springs	.....	1	.....	1	16,608	17,074
Seal Beach	2	.....	355	15	10,193	10,118
Torrance	3	1	52	13	8,756	9,137
Turnbull Canyon	.....	.....	.....	.....	137	178
Whittier	.....	.....	.....	.....	1,015	995
Wilmington	19	25	28,450	129	119,885	99,864
Yorba Linda	.....	.....	.....	.....	.....	551
Miscellaneous	.....	.....	.....	.....	.....	.....
TOTAL LOS ANGELES BASIN	40	45	33,211	279	318,786	307,164
EXPLORATORY						
Outpost Wells	24	.....	.....	.....	.....	.....
Wildcats	20	.....	.....	.....	.....	.....
Gas Wells	8	5	Gas	45	.....	.....
TOTAL CALIFORNIA	200	114	50,226	1,200*	867,236	919,878

*—Includes gas wells completed and 219 drilling wells abandoned.

TABLE II—SUPPLY AND DEMAND FOR PETROLEUM PRODUCTS
PACIFIC COAST TERRITORY
DATA FOR AUGUST OF EACH YEAR

	1941	1942	1943	1944	1945	1946
RAW MATERIAL—B/D						
1. Crude Oil Produced—California	642,308	725,158	779,059	858,830	919,878	867,881
2. Crude Oil from outside 5 Western States	2,014	4,745	4,554	4,428	39,348	3,248
3. Natural Gasoline Produced	38,000	37,000	40,000	43,000	45,000	44,000
SUPPLY OF FINISHED PRODUCTS						
ALL SOURCES—B/D						
4. Natural Gas., L.P.G. and Condensate	6,710	6,419	6,806	10,194	9,935	12,839
5. Gasoline and Naphtha Distillates	255,613	250,129	266,387	321,129	370,387	341,161
6. Kerosene and Kerosene Distillates	1,645	5,774	7,774	(4,516)	7,548	13,419
7. Lubricating Oils, etc.	18,548	11,387	15,290	15,935	13,290	13,161
8. Gas Oil and Diesel Oil	76,226	67,419	86,484	108,613	93,000	96,903
9. Fuel Oil Residuum	276,645	332,000	401,839	375,258	487,419	353,161
10. Asphalt and Road Oils	36,097	48,581	31,451	37,613	26,581	35,968
11. Coke and Other Finished Products	2,806	1,645	968	2,485	5,257	6,129
12. Other Unfinished Oils	(1,548)	(2,355)	(2,968)	2,742	(2,000)	484
13. Refinery Shortage and Gas	27,290	31,259	36,807	44,804	48,323	36,936
14. Crude Oil (Net)	(7,774)	24,838	(9,387)	33,484	(17,581)	29,742
15. TOTAL SUPPLY	692,258	777,096	841,451	947,741	1,042,159	939,903
16. TOTAL DEMAND	723,711	786,775	982,516	883,322	1,010,613	884,516
17. DIFFERENCE	(31,453)	(9,679)	(141,065)	64,419	31,546	55,387
18. Stocks on hand End of each month (Total Bbls.)	142,986,000	131,040,000	118,977,000	91,041,000	76,965,000	85,050,000

Personalities IN THE NEWS



W. Earl Dunn

Fluor Announces Executive Advancements

The Fluor Corporation, Ltd., with main offices in Los Angeles, announces the election of W. Earl Dunn, Vice President to the post of Vice President and General Manager. Mr. Dunn had been in charge of the Kansas City Office for the corporation since 1930. He will headquarter in Los Angeles.

James P. Wiseman

Also, the announcement was made of the promotion of James P. (Jim) Wiseman, former district engineer in Fluor's Houston office to the post of General Sales Manager. Mr. Wiseman will be located in the Los Angeles office.

Both of these appointments were made effective as of October 1, 1946.

Safford Appointed Executive Secretary of Petroleum Equipment Supply Assn.

H. R. Safford, Jr., of Houston, Texas, has been appointed Executive Secretary of the Petroleum Equipment Suppliers Association it was announced by Mr. Hugh H. Glen, President of the Association.

Mr. Safford, a Houstonian since 1924, is a former Vice-President of the Ritchie-Safford, Inc., advertising agency, and has been active in public relations activities as well as civic committee work in Houston. He has just returned from approximately four years service with the Ordnance Department of the United States Army, during which time he was trained in and served as a Counter Intelligence Officer. Mr. Safford was discharged from the Service in April with the rank of Major.

The new Executive Secretary was selected by a committee composed of Directors of the Association. The members of this committee were: Mr. Hugh H. Glen, President, Emsco Derrick & Equipment Company, Los Angeles, Calif., Mr. Ardon B. Judd, Vice-President and General Manager Republic Supply Company, Houston, Texas; Mr. W. M. Bovaird, President, The Bovaird Supply Company, Tulsa, Oklahoma; Mr. Ralph Neuhaus, Vice-President and General Manager, Hughes Tool Company, Houston, Texas, and Mr. Guy A. Tompson, President, Bethlehem Supply Company, Tulsa, Oklahoma.

H. R. Safford, Jr.

The Petroleum Equipment Suppliers Association was originally formed in 1933 in the days of N.R.A. and the multitudinous industrial codes. It is composed of firms who are engaged in the manufacturing and selling of machinery, equipment and supplies used in the petroleum industry, or the furnishing of any service connected with the various branches of the industry. Its membership is national in scope and its aims are the collection and dissemination of useful data and information to its members, the protection and advancement of the mutual interests of the members and the industry generally, and the affording of a means of cooperation with the government on matters of national concern.

The new Executive Secretary will be charged with the duties of coordinating the activities and interests of the Association; serving as liaison between the various committees and committee members.

Parkersburg Executives On Foreign Trip

A. G. Evans-Lombe, Vice President in Charge of Sales and J. A. Lyne, Chief Field Engineer of The Parkersburg Rig & Reel Company left Miami on October 11th for an extended trip through the oil fields of Colombia and Venezuela. They will make the entire trip by air and plan to spend about a month covering all the principal oil fields in the

A. G. Evans-Lombe

two countries. Most of their time will be devoted to studying operating conditions and equipment needs of the South American fields. They expect to arrive back in the United States about November 15th.

Dr. Guy E. Miller, former Shell geologist in the Denver area, has been transferred to the Los Angeles office of the company. The post left vacant is being filled by Alex Clark.

American Airlines presented its award of merit to A. N. Kemp, a member of America's board, in recognition of his wartime service as president of the airline company. Kemp is also a member of the boards of Standard of California and the Arabian-American Oil Co.

Emil Kluth, Pacific Western executive, has left his Los Angeles headquarters for a business trip to Tulsa, Okla., and other points in the Mid-Continent area.

The dinner meeting of the American Association of Petroleum Geologists, Pacific section, at the Mayfair Hotel in Los Angeles, was addressed by Dr. Paul H. Price, state geologist of West Virginia. His subject was "Evolution of Geologic Thought in Prospecting for Oil and Gas."

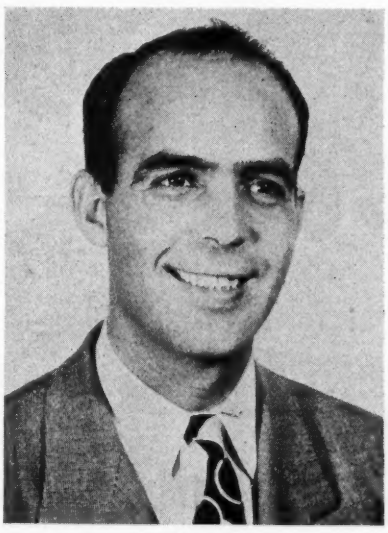
Hickman Advanced by B-J

Byron Jackson Co. announces the assignment of J. E. (Jesse) Hickman to its New York Export Office in the Graybar Building.

Mr. Hickman started in the oil industry at Forked Island, Louisiana in 1936 while still in high school. After graduating from high school, Mr. Hickman was with American Chain & Cable Company until 1939 when he joined Byron Jackson Co. in Houston. He was in the Assembly Department for BJ Elliott Core Drill and had advanced to the Shipping Department when he joined the Navy in December of 1941. Mr. Hickman served in the Atlantic, Carribean, Mediterranean, Pacific and South China Seas before his discharge.

Upon discharge, Mr. Hickman spent several months acquiring the latest information and training in the plants and field services of BJ, Patterson-Ballagh and International Cementers.

Mr. Hickman is now assisting B. A. Hilliard in the BJ Export Office in New York.



J. E. Hickman

Elmer J. Weis Elected To Pacific Pumps Board of Directors

The election of Elmer J. Weis, Vice President of Pacific Pumps, Inc., to the Board of Directors was announced recently. At the same time, he was appointed General Sales Manager. Mr. Weis has been with Pacific Pumps since its establishment by his brother, Arthur R. Weis, now President, and himself in 1923. He is well known throughout the oil industry, having supervised many large installations of centrifugal pumps both in America, and abroad. Mr. Weis' activities at Pacific Pumps during the war contributed greatly to the citations received by the company from the War Department, Maritime Commission, and the War Production Board.

Elmer J. Weis

Los Angeles paleontologists are displaying unusual interest in the fossil animal being shown by Dr. R. A. Stirling, University of California paleontologist. The animal, 30,000,000 years old with all its mineralized bones in place, encloses the fossil of a smaller animal it had eaten before meeting sudden death.

Texas Co.'s discovery the other day off the south end of the McKittrick field, poignantly recalls that much of the preliminary work leading to the test was conducted by R. D. (Bush) Burger, youthful engineer for the company, who passed away a few months ago.

Threads Need Protection

Prolong the Use Life of Tools by Protecting Threads with Rubber

THREAD FAILURE is certain to mean tool failure. Tool failure means delay, loss of time, and expense. Prevent tool failure by using Patterson-Ballagh's new Thread Protector. Made in a variety of sizes for both pin end and box end, Standard A. P. I. right or left hand threads, in regular and full hole types. These Protectors are quickly and easily applied to prevent damage to threads on all heavy items.

In use the Thread Protector makes up on the threads to seat securely against the shoulder of the joint. Molded from tough reinforced PBX Special Rubber, it absorbs shock and shields the threads during handling. Metal Protectors lack bounce and the resiliency to absorb shock and are at times difficult to apply and remove due to rusting and freezing. Patterson-Ballagh Thread Protectors are made of a special rubber, free from sulphur and other ingredients likely to cause rusting. They are vented for drainage, and positively shield threads from damage, wear, tear, rust, and corrosion.

Use Patterson-Ballagh Heavy Duty Thread Protectors on Drill Pipe and all heavy items, such as Drill Collars, Kelly Subs, Fishing Tools, Reamers, Swivels, and Bits. Their *easy use* and long life means great savings in time lost due to tool fitting, re-threading and replacement. PROTECT YOUR THREADS—AND SAVE YOUR TOOLS!

SPECIFICATIONS

Now made in popular sizes—available soon in all standard threads
Full Hole and Regular Types—Pin End and Box End
A. P. I. Left Hand and Right Hand Threads
Light Weight—Low in cost—Last Indefinitely
Sulphur free—Shock proof—Durable
Vented for drainage—Prevent Rusting—Easy to use

Box End Type

Pin End Type

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Security Executives Visit Mid-Continent and Rocky Mountains

Otto Hammer, President and Ken Swart, Chief Engineer for Security Engineering Company, Inc., recently returned from a business trip to the Security Engineering Co., Inc. Branch Offices and Distributing Centers in West Texas, Colorado

Hammer

Swart

and Wyoming. The trip included visits to the operating companies drilling projects where first-hand information on the problems and needs of the operators was obtained.

Kupper Advanced by Ladish

Appointment of W. O. (Bill) Kupper as Manager, Middle Western Sales was announced recently by J. F. Hacker, Manager, Fittings Division, Ladish Drop Forge Co.

A new office which Mr. Kupper will head has been opened at 332 South Michigan Avenue, Chicago, Illinois.

Kupper, formerly Manager of Southern Sales for the Fittings Division of the Ladish Drop Forge Company, will direct the sale of the complete line of Ladish Seamless Welding Fittings, Forged Steel Fittings and Forged Steel Flanges in the middle western area.

After more than 25 years' service, Ray M. Riddle, Shell pumper at Seal Beach has retired. His first job with the company was as a fireman on the Alamitos No. 1 discovery well. Shortly thereafter, he transferred to the production department and started as a pumper in July, 1921.

Al Heller, eminent petroleum geologist and engineer, has returned to his Los Angeles offices from a stay in New York and other important cities along the Atlantic seaboard. In recent months his travels to other climes included a tour of oil areas in Central America. Al's chief interest at the moment, however, is a new home he is building in Arcadia in the shadows of the majestic Sierra Madre mountains.

Clarence Beesemyer, vice president of General Petroleum Corp., is sponsor of a safe-driving campaign to be conducted in cooperation with the National Safety Council, local traffic authorities, police departments and automobile clubs in the 11 western states.

Buaas Drilling Co. (Walter Buaas and Estal B. Munsey) has received contracts from Standard for several wells in the Cymric field. A. W. Lyddon's Lamb Comm. No. 1 in the Huntington Beach active sector is drilling steadily ahead under the supervision of the Santa Maria Drilling Co., which is headed by E. R. Norris and E. J. Simonis.

Clyde Oil Co. has awarded contract to Miller & York for the initial test on the Hopkins lease in the Cymric field. Drilling performance of Standard's deep test on the Middle Dome of Kettleman Hills continues without mishaps at 11,650 ft. Rocky Mountain Drilling Co. is contractor.

"Pat" Robinson New Security Assistant Sales Manager

Security Engineering Company, Inc. announces the promotion of L. G. "Pat" Robinson from California Sales Manager to Assistant Sales Manager. Both by number of years experience and acquaintance with different oil territories the Assistant Sales Manager is well qualified for his new position. Starting with the Company early in Security's history "Pat" Robinson has been stationed in Illinois, Canada, The Mid-Continent, Gulf Coast and California.

In connection with his present duties Pat is attending the Drilling Contractor's Convention at San Antonio, Texas.

Larry Chasteen, Union Oil Co., a member of the American Institute of Mining and Metallurgical Engineers, came in for a round of applause for the excellent publicity job he fostered on the recent petroleum meeting of the association held at the Ambassador Hotel in Los Angeles.

Paul Burley, Signal Oil & Gas southern division office manager, has completed a 7000-mile automobile vacation trip, which carried him through no less than 21 states.

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Kern County OIL NEWS

PROOF OF THE PUDDING is nearly always in the eating thereof. So last month operators here had a fairly good taste of the dessert when subsidies were off and certain price rise was not eligible, as shown in checks from purchasing companies. Diminishing returns having set in, in some quarters oilwigs were comparing notes with rancor toward everyone, including themselves.

DI GIORGIO-UNION tests afforded the best armchair logging two fortnights ago. In a try for a new proving pool, Union went down to come out with 30 b/d instead of the 150 showing which was much estimated and tauted to 500. Meanwhile Richfield went on a try and then Union offset to "spud-in" a threesome to make it a proof for a new underlake of black gold. At the same time Di Giorgio stocks, basically agriculture, were reported upped to a new current high.

HARRY HOPKINS, Kern's own taxpert has completed his final draft of the post budget bulletin on county government costs. The rate set at $2.01 is a new high, and the time is approaching according to the report, when the cost of taxes on real property is holding serious concern. Add other taxes on income and concealments in some inflation, the individual American entreprenuer is facing a dead end. An example: A. has a $10,000.00 income property assessed at $5000.00. He gets $900.00 rental less taxes, repairs, depreciation and insurance and a **few** groceries which leaves him $54.00 in the bank.

CARL EGGERS is probably one of the best known oilwell supply-wigs in Kern County. For 12 years he did business with his own firm plus tens of thousands of contacts. Today he is in the **calories supply business** at Carl's Cafe on Big U. S. Highway 99, the Golden State Highway known as the "Main street of California." Said Carl, "it's faster and more exciting than oil."

"OIL FIELD CONSTRUCTION COMPANY" of Bakersfield is the name of the recently reorganized firm. No change in personnel or service has been effected according to Charles E. Manley, except in his title. He is no longer the Northern Division Manager but the General Manager of what is his own business. The OFCC facility at Long Beach is still maintained and the success of lately installed compressor plants at KNDA and Tide Water Associated at North Belridge made the change seem necessary at this time according to genial office manager and controller R. K. Murdock. Waging a materials control engagement on every turn . . . losing many battle . . . but no war, the Ofco of Bakersfield came through on very good schedule. Learning to say "no" was stricken out of the Ofco language.

JACK TRUMAN who used to sell securities and later matriculated in the oilfield university, says that he is a cousin to the President, but that their political philosophy . . . now differs . . . since he didn't become page at the House of Representatives, where oil helmets are not necessary.

CLARA RYAN at "GP" Taft belongs to the greeters of receiver pullers. Retiring from the "hello" division and general information of "geepee," Clara anticipates enjoying a depreciated "billion dollars in sunshine" somewhere off the coast in Oregon on a ranch . . . that raises fish and pine. Drenched in Kern sunshine for a quarter of a century she will gladly trade it for gentle

OIL FOR THE MASTER'S BODY: Grapes of Gladness greeted the Golden Empire when farmer, oilman and tourist alike reach Delano Harvest and Wine Festival Days. On these days all cars on the Main Street of California U.S. 99 were headed for Delano. While oilmen in Delano are striking it rich in oil, the surface rights boys are stiking it rich in wine.

showers devoted to the land instead of the eyebrows. (Ed Note: Clara Ryan will be reported to the weather committee of the Taft Chamber of Commerce).

NO CHANGE IN WILDCATS is reported from those in the "know-how." Some exploration companies are still eager and eligible for drilling pool money.

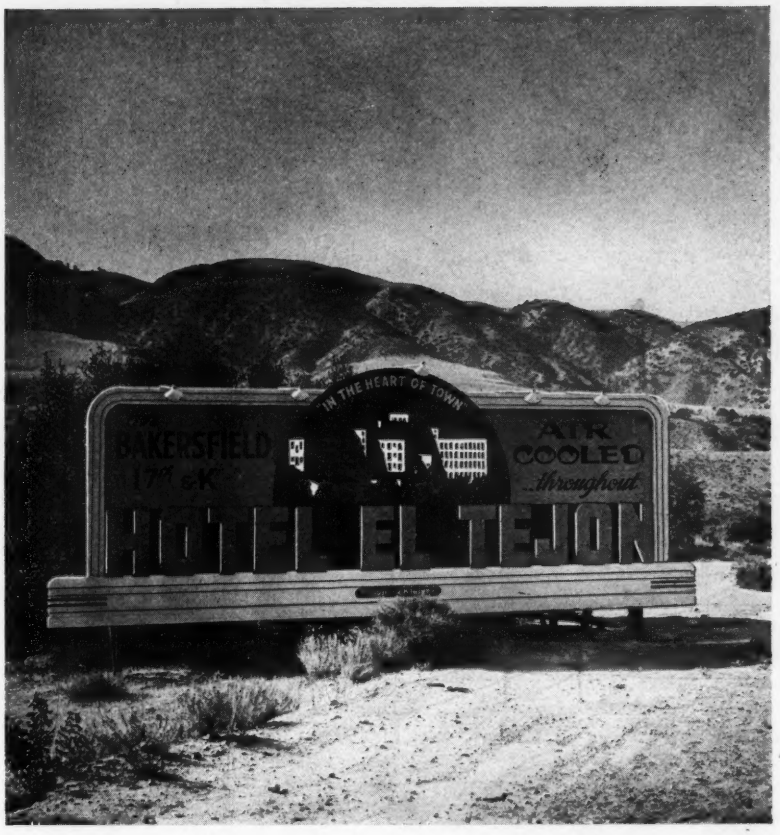
NOT A DERRICK in sight at the Kern County Fair. Even though it was an agricultural affair, doesn't oil come from the soil. So it would seem that petrolwigs might get busy with their public relations department for a good honorable mention, come next fair time, both here and at Sacramento. Those on 9 cent dollars particularly, might do some crusading early.

INCIDENTLY in "Kernconews," "COW" has promised to reproduce pictures of the first second and third grand prizes of the booths . . both at the local and state fairs. Such prize booths also make good blue ribbon reasons why there is a choice of wares even among judges.

AT TAFT all roads that lead to it, are actually being oiled for the "OILDORADO" November 8-11. A celebration of oldtimers and youngwigs alike salute the city of Taft in honor of its founder "Black Gold."

SUPERVISOR A. W. (Andy) Noon who flew to "D. C." in '44 to help prevent public oil land confiscation, returned from a flying trip to Omaha. Here again he opened his traveling bag of "state's rights" before the special envoys of the Interior Department. This time it was water as well as oil. Some mining claims were also mentioned. The Westside is fortunate in having a flying public servant to represent them in this manner.

LLOYD WILLIAMSON came to the oil capital of California last month and paid his respects to all those folks who used to know him "when." Said they who got to see him, "once Lloyd makes up his mind that you are okey you can put it down in your little book that he is with you right or wrong until you get pretty bad." Lloyd has held about every office in most of the state and national associations and committees. Identified with California Star and years in Kern he became a leader in not only trade as-



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ociations but in civic organizations. ater he received a fine promotion o the head office in Los Angeles. ow he is president of his new firm, he Mascot Oil Company. Joe Spelacy at Taft is the superintendent in he Kern County venture. Lloyd's amily is grown up. His boy who eturned early from the war is now ble to drive his own car despite a ad break with enemy gunfire. One f the girls is married, and the other s posting at U of C in public health dministration. Our best wishes to ll.

E. C. (Curley) EMMONS who s so often identified with oldtimers' hindigs, about the oil state is actully growing local color for the Oilorado. At this writing the sagerush and long sideburns make him ok like a Southern Colonel, instead f a Senator as recently reported, acrding to Westside Operator for ildorado news.

NOBODY PARTICULARLY ares if the mailman takes a walk n his day off and it probably isn't ny news. However, when an oilxpert takes an annual holiday to o deer hunting in the shadows of It. Lassen and he is stuck with the

Stockdale Country Club the oilwigs "heaven on earth" between strokes for par and strokes for oil to the ships at sea. Here the Western Oilfields Supply Company installed a new sprinkler system to round out the many services of the oilwell supply industry as regards pipe and specialty installations.

ceremonies of spudding in a well for his own company, that's news. And so with all the hunting paraphernalia for the wiley buck including christening ceremony ingredients, Johnnie Maddrill of General Petroleum's Evaluation department **ran into news.** Up at GP's gas exploration location Johnnie just had to stop in for a little valuation to keep in practice, and someone recognized him. With fanfare and glory after fighting materials shortage JM spent his vacation on a spud job.

PALOMAR'S Mary Eleanor Godbey office secretary of the well known refinery corporation was a lonely passenger on Southern Pacific's Daylight that wends its way through the San Joaquin every day including Saturday afternoons. We watched her at the point of disembarkation but she was not alone for very long. Several Fresnoians serenaded her intiatory, to a successful weekend holiday a fortnight or so ago.

TED FISHER is president of PALOMAR and he has just become accustomed to his old and new uni-

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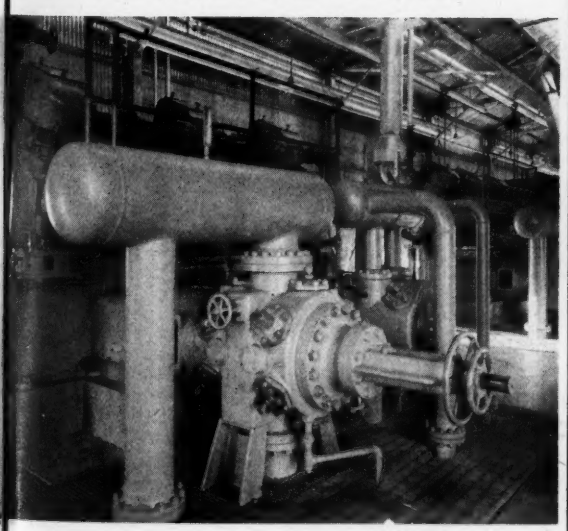

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Baash-Ross News

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OUR 26th YEAR

Maximum Interchangeability

...One of SIX* Casing Head Problems Solved by Baash-Ross

You Can Easily Switch from One Series to Another... From One Flange Size to Another ...From One Tubing Suspension to Another with Baash-Ross Equipment!

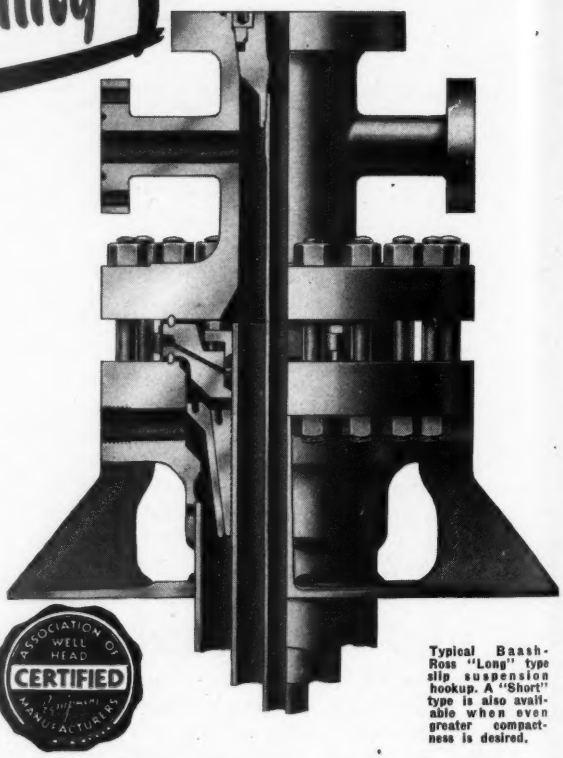
One of many important advantages designed into Baash-Ross Casing and Landing Heads is *maximum interchangeability* of the various units in the hook-up. For example...

CHANGES IN PRESSURE-SERIES: A Baash-Ross Landing and Casing Head hook-up can be quickly switched from lower to higher—or from higher to lower—pressure-series ratings without disturbing previously-installed units or necessitating major adjustments in the well control equipment. And such changes can be made at any stage in the development of the well with slight, if any, effect on over-all height of the completed assembly.

Moreover, with Baash-Ross equipment such changes in pressure series can be made not only through the use of conventional unequal-series flanged casing spools, but also with Baash-Ross Adapter Flange Packing Assemblies. This standard Baash-Ross fitting permits changes in pressure-series ratings without altering overall height of the unit, and also permits changes in casing programs of only two or more strings, whereas the casing spool method generally requires three or more strings.

CHANGES IN CASING PROGRAMS: With Baash-Ross Equipment an additional casing string can subsequently be added to the planned casing program without major changes in the height of the hook-up or the arrangement of the drilling riser assembly.

Or by using a dummy spool, a planned casing string can be readily eliminated without changing the overall height of the hook-up or the drilling riser assembly. Or even if a dummy spool is not used, change in overall height of the hook-up is minimized by the unusual compactness of Baash-Ross units.



Typical Baash-Ross "Long" type slip suspension hookup. A "Short" type is also available when even greater compactness is desired.

CHANGES IN TUBING SUSPENSION: With Baash-Ross equipment last minute changes in the method of landing or suspending the tubing can be made to meet any desired requirements. Selection of Baash-Ross Tubing Suspensions is unusually complete, and since all Baash-Ross Tubing Heads of like series rating are of the same height, changes can be made without affecting overall height of the completed assembly and with few, if any, alterations in the hook-up.

CHANGES FROM CASING HEAD TO LANDING BASE: And here's a unique Baash-Ross advantage... Whenever desired, an already-landed Baash-Ross Casing Head can be readily converted into a Landing Base by simply adding the base and supports.

CHANGES IN EQUIPMENT: Since all flange fittings used in Baash-Ross Well Control Equipment adhere strictly to API specifications, ANY type of control equipment conforming to API specifications is completely interchangeable with Baash-Ross units of comparable pressure series.

Although the above examples are only typical, they illustrate how Baash-Ross Well Control Equipment gives maximum interchangeability to meet changes in well-completion requirements. And this is just *one* of SIX important casing head problems solved by Baash-Ross equipment, making it the most advanced, the simplest, most economical and efficient method available for completing today's wells. Get full details from your nearby Baash-Ross representative...or write direct!

***THE OTHER FIVE**
PROBLEMS SOLVED BY BAASH-ROSS CASING AND LANDING HEAD EQUIPMENT

PERPETUAL
PRESSURE CONTROL
...quick plastic pack-off anytime without breaking connections or killing the well!

WIDE-RANGE
VERSATILITY
...readily adaptable to any number casing strings—any type of tubing suspension!

PRE-TESTED
PACK-OFF
...all welds and pack-offs pressure-tested at time of installation to assure tight seal!

QUICK
EASY INSTALLATION
...base and casing head unitized, handling of drilling riser simplified—and other features!

CELLAR-SAVING
COMPACTNESS
...that cuts over-all height to a minimum without sacrificing strength or safety of assembly!

form discarded in favor of a Major's raiment for the most part of World War II. George E. Brown is the general manager of Palomar and is unable to keep up with the demands for lubes, diesel and other fuels so necessary in the reconversion economy.

SOME TALK IS GOING AROUND about setting aside the great area up from Kern River to its source at Mt Whitney, for a Wilderness. Many an oilman opposed to land grabbing is now thrown for a loss to know what his position might be if he goes out for the wilderness and the Interior boys call it a **park.**

TO THE MIDWAY CONTINENT went Stanley Knouse, Tide Water Scout as reported by Casper newshawks. Mission, obviously exploration. We miss him.

FOR THE FIRST TIME IN FIFTEEN YEARS, our reporter tells us, that at Belridge the deep stuff test well is in the scout news again "NEW" "62 W" has all the appearances left of a No Dope Deal despite latest returns.

SAN JOAQUIN GEOLOGICAL SOCIETY had for its principal speaker, one Dr. Chester Stock, professor of paleontology from Cal Tech, who last month directed attention to the largest animals which played a part in the history of change, millions of years ago. In the pleistocene age which preceded the present, mastodons, horses, and elephants wondered into old La Brea pits covered with water. Soon trapped in asphalt vats which lay beneath, the predators viciously followed only to become trapped themselves to form a vicious circle, as it were, even in the days of then.

TODAY KERN COUNTY IS losing to organized Museums these skeletons of the ages, as expeditions to McKittrick reveal almost a harvest of the timeless ageless fossils most eligible for curators in such collections far from the Golden Empire's boundaries.

AWAKEN THEN all oilmen for Kern has now a Museum Commission. Let's keep from pillaging our own trunk and make a storehouse here for these things of ours. The SJGS has been aroused and they in turn might well program a plan to reconstruct in Kern these sabertooths, the ground sloths, the huge birds and camels embedded in the outcroppings of the earth in plain prehistoric lore. Say those who were present," let's start the first Geological Museum in Kern County." AND WHY NOT. Need we be more dramatic or sincere.

MARTIN VAN COUVERING well known petroleum engineer and so called in dependent consultant from Los Angeles was seen a visitor to Kern the past month. Frank R. Stockton, geologist in his own right and now an independent farmer (if there is one left) was also seen among those advocating a geological museum and in company with Van at the recent meeting of the San Joaquin Geologists.

PRESIDENT Herm Weddle of SJGS reported that Mrs. Weddle was recovering from a trip to the hospital. Herm's many friends here and at Standard's Geological Department were happy to hear that Mrs. Weddle was so greatly improved at this writing.

ONE DAY IN STOCKDALE not long ago we witnessed again the ingenuity of man who makes his golf improved with each shining hour. We told you about the all-fairway showers that keep golfs' memory green. However, we neglected to mention that these sun-drenched sprays form perfect rainbows without clouds. A spectacle to see is Stockdale's water power.

AGAIN WE WANT TO credit Charles P. Lake and his associates who make possible with WoSco's pipe merchandising, a watering system now a thing of efficiency and beauty without soaking their friends who drive down Stockdale's beauty infested fairways.

SINCE OHIO'S strikebound plant is not producing recycling services some talk is going around that a refreshing plant, way out at Taft is now the order of the day. In 27 B zone the quest for this is highly desirable they say. Meanwhile the pause in labor at Ohio is reflected in demands for Seniority rights and not wages as one would think.

JACK ELLERY of El Tejon's community center, its "oil zone" hour and many pleasantries has gone to Stanford for the next semester. Pop Ellery who had him skipping bells for experience and tuition accompanied him on the visit north to stake out distances from the 50 yard line, where pigskin tussels will no doubt feature the Manager's junket many weekends that tend to make it interesting to deliver fraternity assessment vouchers. A dual role will soon obtain. When oilwigs hit the desk for reservations it will not always include a ducket to the game, but it might help in rounding out the reservations to make the trouble double.

PAUL J. HOWARD from Kern has announced his retirement from the mining committee chairmanship and will devote his time to oil affairs in which Kern civic organizations now much concern themselves.

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Are you using the right amount?	☐	☐	☐
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Field Development

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Los Angeles Basin

Dumm Bros. Buy Basin Properties

Dumm Brothers Petroleum Corp. has announced the purchase of the Hogan lease with four old pumpers in the Long Beach Harbor field. The well will be redrilled and brought back onto production.

On the company's recently acquired 25-acre lease on the west side of Baldwin Hills, an old producer has been worked over and is back on production. Work has started on another old well on the lease, which like the first job, will be plugged uphole to the Vickers and Machado zones between 2200 and 2300 feet. Two other wells on the lease are to be plugged back from 8000 feet to around 5700 feet. Dumm obtained the Smith lease from The Texas Co.

Del Valle Adds Well

Bankline Oil Co.'s most recent drilling job on its Black lease in the Del Valle area, Black No. 103, has been finished at a depth of 4450 ft., pumping 225 barrels gross cutting 14 per cent. Foundations are built for Black No. 105 and No. 106. Locations all are in Sec. 13-4n-18w. Bankline's UP No. 8 at the harbor is drilling at 1800 ft. This is a Ford zone project.

Amerada Drills Beach Wildcat

Amerada Petroleum Corp.'s Anaheim Sugar No. 64-7 in the Atha area near Huntington Beach is making hole ahead below 4100 ft. This wildcat is Amerada's first effort in the Los Angeles Basin. Drill site is in Sec. 7-6s-10w.

El Segundo Test Drilling On Down

Northwest of El Segundo, Standard Oil Co. is drilling below 6150 ft. with its Six Companies Fee No. 2 in Sec. 7-3s-15w. This is a follow-up job to a well drilled by Shell for the account of the same half dozen operating organizations.

Mission Valley Test In Sight

A group of San Diego business leaders has under consideration the drilling of an exploratory project in Mission Valley, north of the city limits. During the last decade at least three wildcats have tested ground near the border city. Showings were reported, but of little importance.

Santa Fe Springs Wildcats Drilling

Standard Oil Co. has two tests in the Santa Fe Springs area. Carmenita Comm. No. 1 in Sec. 4-3s-11w is down 9595 ft. and fishing drill pipe. Newsom Comm. No. 1 in Sec. 36-2s-12w is drilling at 1200 ft. At West Newport Beach, the company's McLeod No. 1 in Sec. 18-6s-10w is rigging for pumping trial of the A zone. Tubing is hung at 2005 ft.

Dominguez Test Coring On Down

Union Oil Co. is coring at a depth of 10,261 ft. with its Hellman No. 58, a test in Sec. 27-3s-13w in the Dominguez area. On formation test of the interval of 9487-10,023 ft., blow was fair to weak and increasingly strong during the last 88 minutes while the valve was open three hours and 18 minutes. Recovery was made up of mud and gassy water with a trace of oil.

Inglewood Try Finds New Oil

Basin Oil Co. has been successful in its search for new oil in the Inglewood area, confirmed by completion of Standard Brick No. 1 in Sec. 28-2s-14w, flowing 30 barrels of oil an hour or a daily rate of 720 barrels through a 27/64-in. bean. Total depth is 10,418 ft., with 7-in. casing cemented at 9935 ft. Production is reported coming from the 8th Cal lender zone. The well is credited with some 600 ft. of alternating oil sand and shale.

Location falls on the west extension of the Potrero anticline, not a great distance from previous Basin oil development. Adjacent leaseholders include Bell Oil Co. and L. W. Frankley.

Antelope Valley Test At 1280 Ft.

In the Antelope Valley area of Los Angeles County, Amapola Oil Corp. was last reported at a depth of 1280 ft., with its Amapola No. 1 in Sec. 6-6n-12w.

La Mirada Well Reaches Depth

Near the Santa Fe Railway's La Mirada station, General Petroleum Corp. is drilling at 11,027 ft. with La Mirada Comm. No. 46-1 in Sec. 16-3s-11w, Los Angeles County. What may have been uncovered oil interest to present bottom is known but to the company.

londra Park ry Drilling

British-American Oil Prod. Co., . 1, directly drilling under Alon- a Park, has reached a depth of 00 feet. The well is located in c. 22-3s-14w and is a followup to e discovery well on the Bodger operty. The Texas Co. Operator, rigging up Gardena Comm. No. l in Sec. 26.

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orba Linda ry Drilling

General Exploration Co., Marsh- rn No. 1 in Sec. 23-3s-9w in the orba Linda area is drilling normal- ahead below 5100 feet in a quest r new Orange County production.

---

ewhall Test ishes Cutters

Seaboard Oil Co. is fishing bit cut- rs in its Mission Land No. 8-1 ildcat test in Sec. 25-3n-16w in the ewhall area, with hole bottomed 7527 ft. A swabbing test at 7331-7525 ft. recovered drilling fluid with a little heavy oil. The 7-in. casing is set at 7477 ft.

Olinda Wildcat Makes Progress

Wood-Callahan Oil Co. (Lester Callahan and Jim Wood) is making steady progress with drill in its Coyote No. 1 in Sec. 4-3s-9w in the Olinda area. Depth last reported was 1440 ft.

Beach Continues Active District

Barnhart-Morrow Cons., Alford No. 1 in Sec. 18-6s-10w in the Huntington Beach area was placed on the pump for a yield of oil and water. Original bottom is 3887 ft., with redrilled depth 2526 ft. Casing is set at 2344 ft., and tubing hung at 2350 ft.

Water witch is being run in the A. W. Lyddon, Operator, Crew Comm. No. 1 in Sec. 32-5s-10w, after brackish water was swabbed. The test was drilled to a total depth of 9752 ft. and is plugged at 8700 ft. Lyddon's Lamb Comm. No. 2 in Sec. 6-6s-10w is an abandonment at 6763 ft. His Holtz No. 7-1 in Sec. 7 is drilling at 3350 ft. Irvine No. 7-1 is drilling at 5350 ft.

Signal Pet. of Calif. is running electric log in Deeble No 1 in Sec. 13-6s-11w. Bottomed at 4512 ft., top of lower showings is placed at 4225 ft. The top C zone was found at 3400 ft.

Standard of Calif. is moving equipment in for Deeble-Smith No. 1 in Sec. 13-6s-11w. Tide Water Associated Oil Co., meantime, is drilling its Aldrich Fee in the section at a depth of 4750 ft.

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Coastal and Northern District

San Lucas Well Spuds

The Texas Co. has spudded Cooper No. 1 in Sec. 19-21s-9e in the San Lucas area of Monterey County, and has set surface pipe near 700 ft. The well is 12 miles northwest of the company's idle Aurignac No. 1 and six miles southeast of Currell No. 1, a recent abandonment.

San Joaquin Well Gives Up

Having found nothing of commercial interest to a depth of 6000 ft., Amerada Petroleum Corp. has abandoned Borden No. 1, a gas test in Sec. 33-1n-4e in the Victoria Island area of San Joaquin County. The company has just spudded E. Wineman No. 1 in Sec. 35-6n-2e in the Dixon area, Solano County.

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BAKERSFIELD VENTURA AVENAL

Tip Top Try Ends Search

L. M. Lockhart has abandoned 6713 ft. his Macrate No. 1 wildcat north of the Ventura Ave. field in the Tip Top area on Sec. 27-4n-23w. Bottom is in gray sand below the Vaqueros formation.

Rykers Island Test For Gas

Peter Cook, Jr., Upper Unit No. 1 in Sec. 15-5n-3e in Rykers Island area, Solano County, is drilling ahead below 3800 ft. Cook is prominently identified with gas development in Northern California.

Yolo County Well Rigging

In the Dixon area of Yolo County The Texas Co. is rigging up Stephani No. 1 in Sec. 28-9n-1w. Anderson No. 1 in Sec. 8-2n-1e in the Hydeville area, Humboldt County, is ready to start drilling.

Red Bluff Try Reaches 2200 Ft.

Tehama Exploration Co. has reached a depth of 2200 ft. with Teco No. 1, an exploratory venture in Sec. 30-27n-5w near Red Bluff, Tehama County.

General Seeks Willows Gas

Llano Seco No. 1, sponsored by General Petroleum Corp., in the Willow area in Sec. 33-20n-1w, Butte County, is drilling ahead at 5062 ft. in its quest for new gas supplies.

Sutter County Deepening Job

Buttes Oilfields, Inc., is rigging up to deepen its Buttes No. 7 in Sec. 3-15n-1e in the Marysville Buttes area of Sutter County. Present depth is 5247 ft. Buttes-Wade No. 2 in the section failed to find commercial gas and has been suspended at 7345 ft.

an Ardo y Drills

Drilling ot 7089 ft., C. C. M. O. 's San Ardo No 6-G1 in the San do area, Monterey County, has t to report showings of oil or gas.

est Mountain ell Completed

Pump is being rigged to F. E. irfield's Lemon Co. No. 1 in Sec. -3n-21w in the West Mountain ea, Ventura County. Richardson o. 1, another Fairfield enterprise the section, has been spudded. the South Mountain area, D. D. ldman has finished Richardson tate No. 1 in Sec. 23-3n-21w at 76 ft. for a yield of 45 barrels a y, cutting 31 per cent.

ontalvo Test aking Progress

Northwest of Oxnard in the Mon- lvo area, Standard Oil Co. is drill- g McGrath No. 2 in Sec. 26-2n-23w 8322 ft. Developments to date are company secret.

apitan Test rading Site

Rothschild Oil Co., producer and arketer, is grading drill site for rella No. 1 in Sec. 31-5n-30w in e Capitan area, Santa Barbara ounty.

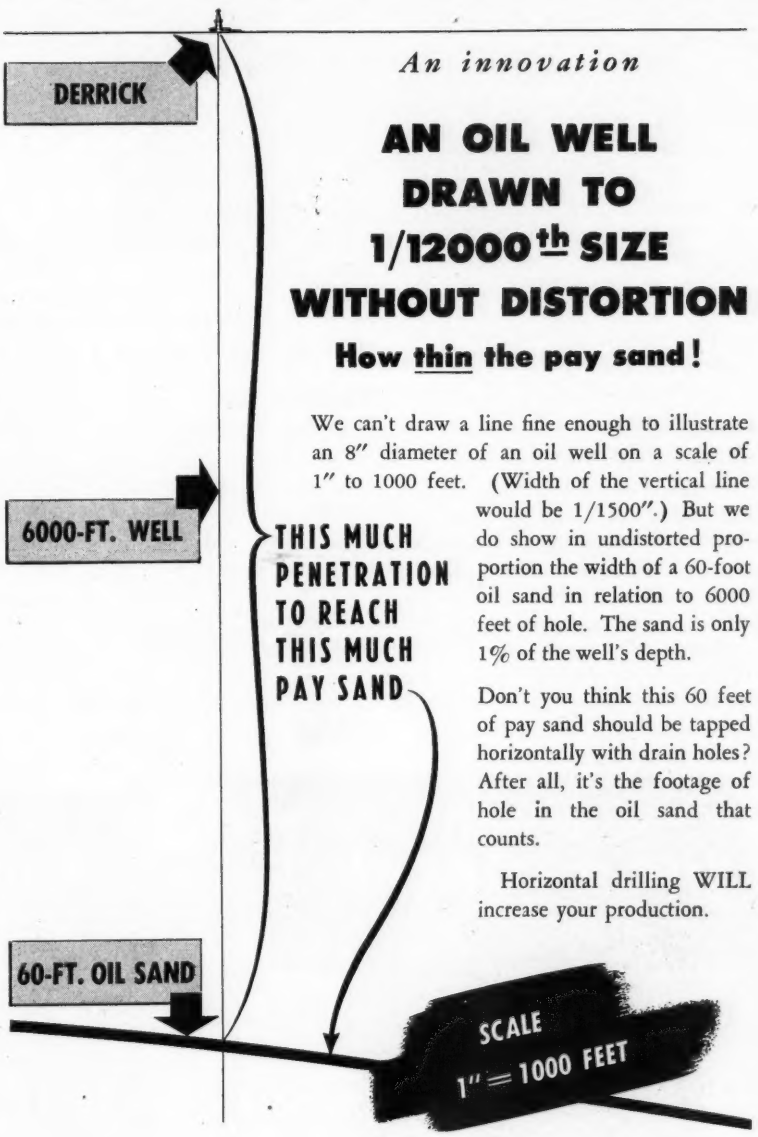
orrey Canyon rilling Scene

In the old Torrey Canyon field of entura County, Union Oil Co. has nbarked upon a new drilling cam- ign. Its No. 66 in Sec. 5-3n-18w drilling at 2205 ft. No. 65 and No. are locations in the section.

anta Maria et Active

The Santa Maria Valley field con- nues an active center. Exeter Oil o., Ltd., Gilliland No. 1 in Sec. 29- -34w is drilling at 1921 ft. C. E. Donnell Oil Co. has made location r Grace No. 2 in Sec. 21. Union il is drilling at 1150 ft. with Rus- ll No. 11 in Sec. 20. Sunray Oil rp. is about to complete Morrison o 1 in Sec. 27 at 5610 ft. The com- ny, meanwhile, is rigging Santa aria Golf & Country Club No. 1 nd Sanders No. 4.

IT'S THE FOOTAGE OF HOLE IN THE OIL SAND THAT COUNTS



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WELL DRILLING

McKittrick Job Flows Wet Gas

Off the south tip of the McKittrick oil field, Texas Co. appears to have discovered a wet gas field. Its West Pet No. 1 on a block of Government leases in Sec. 29-30s-22e was drilled to a total depth of 5173 ft. and on formation test of the interval of 5143 and bottom, flowed wet gas at the estimated rate of 8,000,000 cubic ft. a day. The 7-in. casing is set at 5140 ft. Sand topped at 5143 ft. may be the Oceanic. The well is now ready to be placed on production.

Pyramid Hills Well Oil Failure

Although Glenn Dial has abandoned Miller No. 1 in Sec. 13-24s-17e in the Pyramid Hills area at a depth of 2385 ft., geological information assembled on the way down may be a factor in prompting the launching of another wildcat at a nearby location. The Miller venture found the McLure at 1470 and beds dipping steeply.

General Drills At McKittrick

Shale and chert at 5400 ft. is the last report from General Petroleum Corp.'s Hall-Baker No. 66-4 in Sec. 4-30s-21e in the McKittrick area. Drilling is continuing ahead.

Devils Den Try Digging

S. R. DeKalb is down 910 ft. with Blake No. 14 in Sec. 25-25s-18e in the Devils Den area, Kern County. Nothing of interest has been reported to date.

Temblor Job Rigging Pump

Gannon, Gannon & Aslin are rigging to pump No. 69-J-5 in Sec. 36-29s-20e on the Temblor Ranch in Kern County. Bottom is 660 ft. and casing is set at 570 ft. in oil sand.

Mountain View Well Pumping

L. S. Gilmour & Assoc., Thornber No. 83 in Sec. 14-30s-28e in the Mountain View district has been placed on the pump for a return 50 barrels of 19.8 gravity oil a da cutting very slightly. Corey No. in Sec. 13 is making hole at 4196

Di Giorgio Well Drills

On the Di Giorgio ranch in t area south of the Mountain Vi field, Union Oil Co. is digging wi its No. 62-3 in Sec. 3-31s-29e belo 4300 ft. In the Helm area, the co pany's No. 75-19 has location stak in Sec. 19-16s-17e, Fresno County.

Producer Added In Tupman Area

Flowing at the initial rate of 3 barrels of 34.7 gravity oil and 26 000 cubic ft. of gas daily, Ti Water Associated Oil Co. has giv the finishing touches to its Tupm No. 43-9 in the Arvin area at depth of 6704 ft.

Middle Dome Test Drills

Standard Oil Co. continues prospect ahead at 11,604 ft. with

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ep test in the Middle Dome sector Kettleman Hills. Present formaon is hard shale. In the South ome sector, Tide Water Associed Oil Co. is drilling at 1975 ft. th Fee No. 65-18 in Sec. 18-25se.

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ntelope Hills b To Deepen

Derrick is being rigged to deepen om present depth of 4003 ft., Wilam L. Hernstadt's No. 1 wildcat st in the Antelope Hills on Sec. -27s-19e, Kern County.

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ulare Lake Test eady To Run Liner

Kings County Oil Co. is drilling n Glahn No. 1 in Sec. 4-23s-22e in e Tulare Lake area at 12,878 ft. nough liner is on the ground to set 13,000 ft. and indications are that illing will keep on until that depth reached.

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dison Area est Listed

Los Nietos Prod. & Ref. Co., has cation staked for Cauzza-Portals o. 1 in Sec. 31-29s-29e, northwest the Edison field.

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elridge Venture esumes Drilling

Richfield Oil Corp. has resumed illing at 4485 ft. with its Berry o. 1, a scheduled deep test in the uth Belridge area in Sec. 30-28se. Location is two miles northst of Belridge Oil's deep prospect. is being drilled under an agreeent with other large property holds in the area, including Union, andard, Shell, General Petroleum, erry and Universal Consolidated. Richfield is going ahead with its rehole campaign in the area. nion Corehole No. 1 in Sec. 19-28se was abandoned at 1142 ft. St. air Corehole No. 1 in Sec. 24 is illing at 1104 ft.

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en Section y Digs On

After running electric log to 9512 and sidewall sampling, Shell Oil is drilling ahead at 9572 ft. with KCL-A No. 53-30 wildcat in Sec. 30s-26e in the Ten Section area, rn County.

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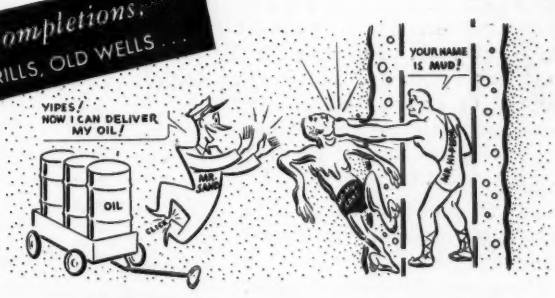

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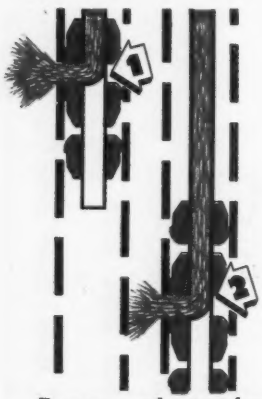
San Joaquin Valley

Seaboard Active In Valley Areas

Seaboard Oil Co. is rigging derrick for an interesting wildcat test, known as Seaboard-Bandini No. 3-21 in Sec. 21-28s-20e in the Bacon Hills area of Kern County. On the east fringe of Ant Hill, the company is nearing the spudding stage with its Seaboard-Richfield No. 76-36 in Sec. 36-29s-29e. Near Buena Vista Lake, SWUM-BVA No. 73-14 in Sec. 14-32s-25e is drilling hard shale at 12,432 ft.

The Bacon Hills explorer is located two miles northwest of Bandini Petroleum's Bacon No. 1, which was abandoned last March at a depth of 11,000 ft. All tests uphole by stages reacted wet.



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Belridge Test Recovers Fish

Having successfully recovered fish, Belridge Oil Co. is ready to drill ahead from a depth of 13,950 ft. with its No. 62-W-33 in Sec. 33-28s-21e in the South Belridge area.

In Sec. 8-29s-21e, Clyde Oil Co., headed by Clyde E. Greathouse has spudded its Hopkins No. 56-8 and is drilling in shallow formations. The test is located on property owned by Union Oil Co. Clyde Oil, however, owns 160 acres adjacent to the property.

Buena Vista Well Deeper

Continental Oil Co.'s BVA No. 1 explorer in Sec. 8-32s-25e in the Buena Vista Lake area is making hole ahead in hard shale at 9723 ft.

Arvin Project Still Testing

Western Gulf Oil Co.'s interesting test on the Di Giorgio ranch in the Arvin area is testing shut off on 7-in. casing cemented at 5877 ft. On formation test between 5876 ft. and bottom of the hole at 6104 ft., gas showed in 5 minutes, with recovery 600 ft. gas-cut oily mud. On a retest of the interval of 5877-6104 ft., blow was light and steady. Recovery consisted of 515 ft. gas-cut mud. Adjacent leaseholders include Bolsa Chica Oil Corp. and Union Oil Co. Location falls in Sec. 20-31s-29e.

Western Gulf's San Emigdio No. 1 in Sec. 19-11n-22w in the San Emigdio area may be redrilled. Original bottom is 3818 ft., with plug at 2737 ft.

Williams Anticline Venture Rigging Up

In the Williams Anticline area of Kern County, Signal Oil & Gas Co. is rigging derrick to start the drill in its Signal-Honolulu-Carpenter No. 1 in Sec. 6-28s-19e.

There are now 4,637 drilling rigs in operation in the United States, of which 2,980 are rotary and 1,657 cable-tool type.

aroid Announces ew Line

Baroid Sales Division, National ead Company, announces a com-lete line of Drill Pipe Wipers in ew replaceable-insert and one-piece ypes. These wipers are said to have ll the advantages of conventional ipers plus:

(1) Replaceable inserts. When ear or damage from tool joints or rotectors makes the Baroid Wiper neffective, the operator need only eplace the worn insert. This re-lacement makes the wiper good for nany more thousands of feet of ipe at a fraction of the cost of a ew wiper. One rim will outlast everal inserts.

AROID PIPE WIPER expanded to permit he passage of a protector on a string of rill pipe. Flexible design permits easy passage of protectors.

(2) Tapered Center Hole. Taper provides greater wiping efficiency and longer life because of more even distribution of pressure on wiping surface.

(3) Raised Center Hub. Extended hub gives greater wiping surface and does a correspondingly better wiping job.

(4) Strong, Flexible Construction. Radial ribs strengthen wiper yet allow easy stretch to permit passage of joints and protectors. Uniformly blended rubber securely joined to steel reinforcing ring provides great elasticity and long wear.

The Baroid Drill Pipe Wiper (Type RC) is available with replaceable inserts which are said to extend wiper life several hundred per cent. The conventional one-piece Baroid Wiper (Type S) embodies the same advantageous features as the Type RC with the exception of the replaceable insert.

By using the Baroid (Type RC) Replaceable-Insert Wiper, operators do not have to discard worn or damaged wipers. They can either bolt or lace in a new insert, using whichever method they prefer. This easy operation requires no special tools and can be accomplished in a few minutes.

The replaceable-insert also eliminates the need of additional wipers for different sizes of drill pipe. One wiper rim with two inserts of the proper sizes will serve two sizes of drill pipe, thus effecting another substantial saving. If the drill collar, stabilizer, or bit, damages the insert, only the insert need be replaced.

Both the replaceable-insert (RC) and one-piece (S) Types of Baroid wiper are available in outer diameters of 14", 15", 17" and 19". Each of these sizes is manufactured for both 3½" and 4½" drill pipe.

New Quick-Opening Unitized Block Developed By Baash-Ross

Baash-Ross Unitized Blocks have become widely famous throughout the oil industry for the unique advantages they offer on portable rig operations, production jobs and similar work. These Blocks combine—in **one** compact unit— both a Traveling Block and a free-swiveling Hook or Link Adapter connector, thus eliminating the space usually wasted by bails between these two units and providing an unusually compact and convenient Block assembly.

Now, through development of the new DBH Unitized Block, another unique convenience has been incorporated into this equipment. The DBH Block is so designed that you simply pull one pin and the entire Block opens to apply the lines in the sheaves. Just lay in the lines, close the Block, replace the pin—and the Block is ready for use!

This new hinged construction simplifies all types of rigging-up operations. Instead of having to reeve lines through the Block or remove the guard to expose sheaves, simply pull a pin, open the Block and lay the lines in place. On rig-to-rig production work the operator can leave the lines hanging in the derrick between jobs. When production work is necessary, the crew simply lays the loops into the Block, closes it and the crew is ready to work in a fraction of the time ordinarily required for reeving the line. It not only saves time and saves work, but is also a definite safety advantage because there is no need for risky crown operations to reeve the lines. And there are still other ways this new Baash-Ross development speeds and simplifies rig-operations.

Available in Two Types and Many Sizes

The Baash-Ross DBH Unitized Block is available with either a built-in Hook connection or with a built-in Link Adapter for holding the elevator links. By using the Link Adapter and a Baash-Ross Swivel Bail Adapter on the Swivel, the operator can run pipe and support the drill string with the **same** elevator assembly, thus simplifying operations and saving valuable derrick space.

In addition to the two basic types of connectors, DBH Unitized Blocks are available with 1, 2, 3 or 4 sheaves in a wide range of sheave diameters and with load ratings from 30 to 150 tons. On all units the free-swiveling Hook or Link Adapter can be quickly locked in any one of eight equally-

spaced positions whenever desired.

Further information on this new development can be obtained by writing Baash-Ross Tool Company, 5512 South Boyle Ave., Los Angeles 11, California.

Fluor to Exhibit at National Power Show

The Fluor Corporation, Ltd., of Los Angeles, engineers, designers and manufacturers of equipment for the oil and gas industries, will have a unique exhibit at the coming National Exposition of Power and Mechanical Engineering, to be held in New York City, December 2-7, 1946.

The exhibit will be a working model of the Fluor Pulsation Dampener, a device that changes pulsative flow into a smooth, steady stream. Pulsative flow, set up in air, gas and vapor lines wherever reciprocating-type compressors are the source of power, has long been a problem for pipe line operators and compressor station engineers to mull over. However, until the Fluor Pulsation Dampener was introduced a little over a year ago, very little had been done to eliminate pulsative flow, although several devices have been used to lessen its effects. Vibration, a direct result of pulsative flow, has been lessened to a degree by the use of mechanical gadgets such as springs, pipe clamps, vacuum bottles, etc. In some cases, pipe line vibration has been so great as to necessitate over-sizing of pipe lines to urevent them from breaking.

The Fluor Pulsation Dampener, installed on either suction or discharge side of compressors, or both, by converting pulsative flow into a steady stream greatly reduces pipe line vibration and helps correct some of the other ramifications, such as horse power losses, inaccurate orifice meter readings and vibration due to air surge on engine intakes.

Fluor's working model consists of a small electric-driven compressor with Pulsation Dampeners installed on both the suction and discharge sides. A lever on either side enables the spectators to route the flow through the Pulsation Dampener or to by-pass it. When the Dampener is in operation, a pressure gauge remains motionless, but when the Dampener is by-passed, the gauge vibrates considerably. A pressure-recording chart is also hooked up to graphically depict the difference between pulsative and steady flow.

McCullough Ventura Office Moves to New Building

Because its expanding gun-perforating and fishing tool service in the Ventura area demanded greater shop facilities, the McCullough Tool Company has erected a new hollow-tile and concrete building at 1213 Ventura Avenue. The greatly increased shop facilities in the new headquarters are expected to allow considerable expansion of service.

Al Pruitt remains as district manager in charge of the new office. With him are Pete Oaks, on fishing tool service, Hap Miller heading gun perforating service, Jess King, Harry Gilmour and Vearl Sanders. The telephone number is Ventura 4425.

STATEMENT OF OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACTS OF CONGRESS OF AUGUST 24, 1912, AND MARCH 3, 1933.

Of California Oil World, published twice-monthly at Los Angeles, California, for October 1, 1946. State of California, County of Los Angeles, ss.

Before me, a Notary Public in and for the State and county aforesaid, personally appeared Walter C. Monroe, who, having been duly sworn according to law, deposes and says that he is the President and Business Manager of the California Oil World, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, as amended by the Act of March 3, 1933, embodied in section 537, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, Walter C. Monroe, 765 S. Plymouth Blvd., Los Angeles 5, Calif. Editor, Walter C. Monroe, 765 So. Plymouth Blvd., Los Angeles 5, Calif. Managing Editor. None. Business Manager, Walter C. Monroe, 765 So. Plymouth Blvd., Los Angeles 5, Calif.

2. That the owner is: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding one per cent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a firm, company, or other unincorporated concern, its name and address, as well as those of each individual member must be given): Petroleum Publishers, Inc., 117 W. 9th St., Los Angeles 15, Calif.; M. K. Miller, Jr., 7367 Hollywood Blvd., Los Angeles, Calif.; Walter C. Monroe, 765 So. Plymouth, Los Angeles 5, Calif.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: (If there are none, so state.) None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

5. That the average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the 12 months preceding the date shown above is: (This information is required from publishers of daily, weekly, semi-weekly and tri-weekly publications only.

WALTER C. MONROE
(Signature of editor.)

Sworn to and subscribed before me this 4th day of October, 1946.

(SEAL) GLADYS BOWEN,
(My commission expires Feb. 26, 1947.)

New Edna Well Pumps

Adams Oil Co. has rigged Adams No. 2 in Sec. 31-31s-13e in the Edna field, San Luis Obispo County, to the pump for an unestimated yield from a perforated interval at 933-1266 ft. Total depth is 1268 ft.

AIME Meeting

(Continued from Page 17)

While the authors presented only calculated results, a number of drawdown and cycling tests were conducted in a tube packed with unconsolidated sand originally containing dew point material. The results of these tests were stated to verify the calculated results.

Behavior of Reservoir During Pressure Decline

Samples of gas and liquid from a high pressure trap were recombined in a PVT cell, it was explained, to give a dew point of 2960 PSIA at 195°F.

The PVT behavior of the system was determined by removing successive small quantities of gas from the cell. Thermodynamic equilibrium was established after each removal. Retrograde liquid volumes and the gravity of the effluent gas were measured at each step. Such a procedure was given as equivalent to assuming the production of only gas phase material from the reservoir. This is believed reasonable because oil will not flow from the reservoir at low liquid saturations.

The composition of the retrograde liquid formed during pressure decline was computed on the basis of reported equilibrium constant data. The calculation procedure considered the removal of successive small portions of equilibrium gas phase from the system, followed at each point by a new equilibrium between the gas and liquid remaining in the system. This scheme the authors stated, corresponded to the differential removal of gas phase from the PVT cell described above. At every point, however, the equilibrium constant of the heptanes-plus fraction was adjusted until the calculated quantity of liquid in the system agreed with that determined experimentally in the PVT cell.

Parks On "What Engineers Expect From Management"

Ernest K. Parks presented results of engineers' replies to his survey of opinion designed to disclose "What the Engineer Expects from Management." Replies were received from geologists and engineers in oil field work, including development, production, construction, and gasoline plant operation. A questionnaire was sent to those on mailing list selected to reach a large proportion of oil field engineers employed in the San Joaquin, Coastal, and Los Angeles districts. Those who replied were classified as to principal activity, years of service, size of organization, and other items and answered forty questions as to management-employee relationships, including points as to collective bargaining. In addition a great many well constructed recommendations were received in answer to the final question, "Please state in a few words of your own the most important and definite thing you as an engineer expect from management." Results have been disclosed in detail by the use of punched cards and the business machine analyser and the author gave these results supplemented by his interpretation of their significance.

"Evaluation of Absorber Operating Efficiency"

(Continued from Page 34)

When this efficiency relationship is coupled with the fact that all operating lines for all columns can be drawn as straight lines passing through unique pressure focal points, it is seen that only one additional operating point need be located to completely identify a column's effectiveness (or efficiency). If this additional point is then located on a conveniently chosen "percent recovery" reference line, the column's effectiveness at any given pressure can be accurately identified by a single "efficiency rating" number, i.e., by the value of A_E for that particular reference percent recovery. In our work we have chosen 95% for this reference base.

Proper utilization of these straight line chart relationships makes it possible to:

> "Accurately specify, and check, a column's effectiveness without the need of running on a precise quality of feed stock, or effecting a precise recovery of a given key component."

The many advantages inherent in such a specification flexibility are, of course, obvious.

And back of these specification advantages lies another extremely interesting possibility of the straight line chart, namely:

> "Accurately comparing the operation of a given column with the best of commercial units without having to run the column in question under any particular pre-set conditions of control."

Unfortunately, full attainment of this second goal is dependent on the analysis of a great deal more operating data than appears available at the moment. However, we have made a start in this direction with the results shown on Fig. 10.

On this chart we have plotted values of A_E at 95% recovery against the log of the absolute operating pressure for the most efficient columns studied to date—with the number of trays utilized in each column being noted, and lines of fixed tray number being drawn through them. If sufficient high efficiency data were available, such a chart would clearly specify the complete range of operation of the industry's most efficient units. In our case, however, it merely indicates what may be accomplished in the future.

Our meager results are presented for what they are worth. While we have no means of knowing whether or not the subject columns were operating at approximately the same relative efficiency, it is interesting to note that a rough pattern is established which exhibits the proper relationship between A_E requirements and number of trays employed. While crude, it is certainly a first step in the right direction—namely, to make it possible for the plant operator to quickly and accurately determine whether or not his own plant equipment is "up to the industry's best standard", and if not, in what degree it departs from that standard.

To us, the most outstanding feature of this first attempt at an overall industry column comparison was that out of some 40 columns analyzed, only five units fully qualified for inclusion in the maximum efficiency grid—with two or three others presenting some evidence that with more complete testing they

also might have made the grade.

In other words, only 20% at the very outside of all columns studied were operating at efficiencies approximating the industry's best indicated standard at the time of testing —which fact is certainly a challenge to both the operator and the designing engineer.

In meeting this challenge, an accurate and consistent measure of column performance is the first essential. For this service we offer a new process tool, "The Straight Line Chart"—confident that it will live up to its initial promise of consistently evaluating the absorber performance throughout its operating range.

In closing, we wish to acknowledge our heavy indebtedness to the many individuals and companies who have so generously contributed data to this study, and without whose help this work could never have been accomplished.

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Miramonte Test Getting Deeper

One of the most interesting wildcat tests in the state is Pacific Western National Royalties No. 1 in Sec. 5-26s-22e in the Miramonte area, Kern County, which has reached a depth of 15,675 ft. and continues to drill on down in quest of the objective Vedder.

Fairview Job Making Hole

In the Fairview area of Orange County, Tide Water Associated Oil Co. is making steady headway at a depth of 5471 ft. with Norris No. 1, an exploratory project in Sec. 8-6s-10w.

East Los Angeles Lists New Projects

Richfield Oil Corp. is grading ground for U. P. Unit No. 3 in Sec. 16-2s-12w in the East Los Angeles area. Flood Control No. 1 in Sec. 14 has been given up at 9255 ft. Boyle Comm. No. 33-1 in Sec. 31-1s-12w is reaming. Total depth is 4739

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